

STUDENT GUIDE TO THE WEILL CORNELL/ROCKEFELLER/SLOAN KETTERING TRI-INSTITUTIONAL MD-PHD PROGRAM 2016-2017

> **Program Director** Olaf S. Andersen, MD

Associate Directors Jochen Buck, MD, PhD Mark S. Pecker, MD

> Administrative Director Ruth Gotian, MS, EdD

Administrative Staff Gloria Chan – Data Management & Education Assistant B. Renee Horton – Ădministrative Assistant Hanna Silvast - Financial & Budget Specialist

This guide describes the organization of the Weill Cornell/Rockefeller/Sloan Kettering Tri-Institutional MD-PhD Program. The guide is intended to help students become familiar with the Program and conduct their studies in a productive fashion. The guide thus amounts to the current "rules" governing the program. These rules may evolve, and this guide may be amended from time to time. Under the terms of the Tri-Institutional Agreement governing the administration of the program, the Program Director has the ultimate authority to interpret or change existing rules. The Program Director will be available for discussion and clarification regarding any aspect of the program.

It is the policy of Weill Cornell Medical College, The Rockefeller University, and the Memorial Sloan Kettering Cancer Center to support the equality of educational opportunities.

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## **Contact Information:**

#### **TRI-INSTITUTIONAL MD-PHD PROGRAM OFFICE**

1300 York Avenue, C-103 New York NY 10065-4896 Tel: (212) 746-6023 Fax: (212) 746-8678 mdphd@med.cornell.edu www.weill.cornell.edu/mdphd

> Olaf S. Andersen, MD Program Director (212) 746-6023 sparre@med.cornell.edu

Ruth Gotian, B.S., M.S. Administrative Director (212) 746-6023 rgotian@med.cornell.edu

Jochen Buck, MD, PhD Associate Director (212) 746-6023 jobuck@med.cornell.edu Mark S. Pecker, MD Associate Director (212) 746-6023 mpecker@med.cornell.edu

#### mpecker@med.comeil.

#### **RESEARCH ADVISORY COMMITTEE**

Hugh C. Hemmings, Jr., MD, PhD Weill Cornell Medical College hchemmi@med.cornell.edu Ross L. Levine Sloan Kettering Institute <u>leviner@mskcc.org</u> Sohail Tavazoie, MD, PhD The Rockefeller University stavazoie@rockefeller.edu

OFFICE OF ACADEMIC AFFAIRS AT WEILL CORNELL MEDICAL COLLEGE

Weill Cornell Medical College, C-118 Tel: (212) 746-1050 Fax: (212) 746-8935 academicaffairs@med.cornell.edu www.weill.cornell.edu/education/

WEILL CORNELL GRADUATE SCHOOL OF MEDICAL SCIENCES

Weill Cornell Medical College, A-131 Tel: (212) 746-6565 Fax: (212) 746-8906 gsms@med.cornell.edu www.weill.cornell.edu/gradschool/

DAVID ROCKEFELLER GRADUATE PROGRAM

The Rockefeller University, Founders Hall, Room 105 Tel: (212) 327-8086 Fax: (212) 327-8505 phd@rockefeller.edu http://www.rockefeller.edu/graduate

**GERSTNER SLOAN KETTERING GRADUATE SCHOOL OF BIOMEDICAL SCIENCES** 

Memorial Sloan Kettering Cancer Center, Zuckerman Research Center 669 Tel: (646) 888-6639 Fax: (646) 422-2351 gradstudies@sloankettering.edu http://www.sloankettering.edu/gerstner/

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#### The mission of the Tri-Institutional MD-PhD Program is to educate and train physician-scientists, who are prepared to bridge the gap between laboratory research and clinical medicine and thereby contribute toward improving health and enhancing the quality of life by reducing disability and death from disease.

## INTRODUCTION

The Weill Cornell/Rockefeller/Sloan Kettering Tri-Institutional MD-PhD Program comprises Weill Cornell Medical College (WCMC), The Rockefeller University (RU), and the Sloan Kettering Institute for Cancer Research (SKI) – three biomedical research and educational institutions that are in close geographic proximity.

The three institutions recognize the national need for training biomedical investigators who possess two complementary skills. On the one hand, they should have an advanced understanding of biomedical science and a mastery of contemporary research skills, which will allow them to undertake fundamental studies to elucidate basic biological processes pertaining to human disease. On the other hand, they should be well grounded in human biology, pathobiology and clinical medicine, and thus equipped to transfer advances in basic research to the understanding, prevention, and treatment of human disease.

This combination of skills is necessary if society is to exploit fully the explosive advances in the basic biological sciences to improve public health. Moreover, major research advances will continue to come from scientists who are motivated by the intellectual challenges of disease-oriented research in their search for new biological discoveries. The three institutions have found that a successful approach to developing such physician-scientists is to operate a dedicated MD-PhD training program that is charged with identifying and attracting outstanding students, who have a strong desire to become physicians and yet manifest an informed commitment to research careers. In addition, the MD-PhD Program should guide these exceptional students through a rigorous course of study that offers individual flexibility and unrestricted access to experienced mentors in leading laboratories. Graduates of such a program should be equally well prepared to work in the laboratory or at the bedside—and therefore able to bridge the (widening) gap between clinical medicine and laboratory research, which is brought about by technological developments and specialization in both fields.

Clinical medicine and laboratory research have many rewards—and potential frustrations. The Tri-Institutional MD-PhD Program recognizes that a scientific career is a challenging undertaking. In addition to the challenges that are common among all professional careers, there are particular challenges associated with dual-degree careers: the training is long; and it is difficult to manage the conflicting demands of clinical, laboratory and family responsibilities. During your training, we provide guidance for how to plan your studies, and how to deal with the challenges that you will encounter throughout your stay in the program—and in your future career—while preserving the flexibility for which the program is renowned.

The Tri-Institutional MD-PhD Program comprises one medical college, WCMC, and three graduate schools: RU; Weill Cornell Graduate School of Medical Sciences (WCGS), which is a joint undertaking of SKI and WCMC; and the Gerstner Sloan Kettering Graduate School of Biomedical Sciences (GSK). The unique structure of the program provides you with extraordinary resources and opportunities. It also is a source of uncertainty, which we hope to minimize with this Guide. Please note, however, this is only a guide – not a substitute for the policies that govern your education and training in WCMC or the graduate schools. These policies are updated regularly, and it is your responsibility to abide by the policies of the training component in which you are matriculated.

## TRI-INSTITUTIONAL MD-PHD PROGRAM

#### OVERVIEW OF THE TRAINING PROGRAM

The goal of the Tri-Institutional MD-PhD Program is to train the next generation of leaders in academic medicine and biomedical research – in a manner that promotes an effective intellectual dialogue between the research and the clinical settings. Graduates of the program will have excellent research credentials and be well qualified for the practice of medicine.

During their training, the students are guided by the *Research Advisory Committee* and the *Career Counseling Committee*. The *Research Advisory Committee* guides students in their choices of rotation and thesis laboratories. The committee is composed of the Program Director (who chairs the committee) and a representative of the graduate faculty at each of the institutions. The three institutional representatives also are available to discuss specific issues pertaining to their institution. The *Career Counseling Committee* guides the students during their research years, especially during the transition from the research years to the final clinical clerkships, and provides advice about long-term career planning (post-graduate clinical training, etc.). The Committee is chaired by Mark S. Pecker, MD, and composed of members of the Research Advisory Committee, and additional members from the WCMC faculty.

#### THESIS ADVISOR

Any member of the faculties of the participating graduate schools at the equivalent of Assistant Professor or above can serve as research advisor for MD-PhD students. For the purposes of the MD-PhD Program, the responsibility for a student's research guidance and progress rests with the head of the laboratory in which the student is working. At WCMC the advisor must have a WCGS faculty appointment in a PhD degree-granting graduate program; at RU the advisor must be a Head of Laboratory; and at SKI, the advisor must have a WCGS or a GSK faculty appointment. For program purposes, only these individuals are eligible research advisors.

Students in the Tri-Institutional MD-PhD Program are expected to do their thesis research in a laboratory (or in laboratories) in one (or more) of the participating institutions. MD-PhD students can, as part of a collaboration, spend time visiting an off-campus laboratory; but they cannot do the major part of their thesis research off-campus. MD-PhD students, however, can move with their thesis advisor, and remain Tri-Institutional MD-PhD students, if they have spent more than one year working in the advisor's laboratory when the advisor moves from the Tri-Institutional campus to another PhD degree-granting institution. The advisor would be responsible for the student's stipend, health and dental insurance while the student is off-campus; the MD-PhD Program would resume responsibility when the student has defended and submitted her/his thesis to the appropriate graduate school office and returned to the final clinical training.

#### **DURATION OF TRAINING**

The goal for completing the MD-PhD training is seven years, with a possible additional year. Each student's training path will be unique, and it is difficult to predict the rate of progress. Students therefore are encouraged to consult with the Program Director regarding any difficulties that may affect their progress through the program. If a student needs more than eight years to complete the program, the student and her/his advisor must petition the Program Director for an extension (for a total of nine years of study). The maximal duration of the training is 10 years, not including leaves of absence: 3.5 - 4 years of medical college education and clinical training; and 6 - 6.5 years of graduate school education and research training. If a students needs 10 years to complete the Program, the Program Director will consult with the Program's Advisory Committee before making a decision.

#### **ELEMENTS OF THE TRAINING PROGRAM** (For a more detailed description see Pp. 5 – 10)

1. **Medical College Education I** (two years) In addition to the WCMC curriculum, MD-PhD students complete two required graduate level courses (*Frontiers in Biomedical Science I & II*) and two-to-four research rotations (in at least two different research institutions). The students also take a course in the *Responsible Conduct of Research* during their first summer in the Program and *Introduction to Clinical and Translational Research* (in the fall of year 1 of the combined degree training CD1).

Students should have selected their thesis advisor, and matriculated in the graduate school in which the advisor has her/his primary faculty appointment, by September 1 of year 3 of the combined training, CD3.

2. **Graduate School Education and Thesis Research** (three and a half years to four and half years) MD-PhD students take four course units (four quarter-long graduate courses), chosen in consultation with their thesis advisor, and write and defend a thesis research proposal. These requirements should be satisfied no later than October 31 of CD4. The formal requirements differ slightly among the graduate schools; but MD-PhD students can elect to fulfill their formal, non-course-work requirements according to the standards of any of the graduate schools — irrespective of the graduate school in which they are matriculated.

During their thesis research, MD-PhD students are encouraged to sample different medical disciplines—to allow them to make more informed decisions about their selection of residency programs. These explorations will be brief electives, guided by *Career Counseling Committee*.

3. Medical College Education II (14-21 months) Following the completion of their thesis research, MD-PhD students complete their medical college clerkship training to satisfy the requirements for graduation and licensing (57 weeks, of which 14 - 18 have been completed in the spring semester of CD2). They also will have time to pursue research and clinical electives.

#### PRESENTATIONS

Once they have defended their TRP, all MD-PhD students in research training must annually present original data in a formal scientific venue. This requirement can be fulfilled by presenting a **talk** at the annual MD-PhD retreat, the Du Vigneaud Memorial Symposium hosted by the Weill Cornell graduate school, or various departmental/institutional seminar series or retreats, or a **poster** or **talk** at any national or international scientific meeting. Fulfillment of this requirement must be verified at the second of the student's bi-annual committee meetings. Students are required to submit to their committee and the MD-PhD Program office the abstract of the presentation.

#### PUBLICATIONS

It is the expectation that MD-PhD students will have at least **one first-author research article** published or in press in a peer-reviewed journal by the time they graduate from the program.

#### TIMETABLE OF MD-PHD TRAINING

The overall "timeline" (including critical dates) of the training program is summarized below (for a seven-year program of study). A more detailed description of the training program is provided on the following pages. The academic year is defined to begin September 1.

#### Activities Date Research Rotation #1; Careers in Biomedicine Summer Series Summer before CD1 Responsible Conduct of Research First Year Medical College Curriculum CD1 Frontiers in Biomedical Science I Introduction to Clinical and Translational Research Research Rotation #2; Summer of CD1 Careers in Biomedicine Summer Series Second Year Medical College Curriculum (including USMLE Step 1 and clerkship training) CD2 Frontiers in Biomedical Science II Summer of CD2 Research Rotation #3 (and, maybe, 4) Choose thesis laboratory Start of CD3 (September 1) Register at GSK, RU or WCGS Thesis Research Complete graduate course requirements CD3 Select Faculty Advisory or Special Committee Thesis Research Submit and defend Thesis Research Proposal CD4 (by August 31 and October 31, respectively) Submit application for individual fellowship support Committee meeting (in late spring)

#### MD-PhD TIMETABLE (Seven-Year Plan)

	Thesis Research
	Responsible Conduct of Research
CD5	Two annual Committee meetings (late fall and spring)
	Inform MD-PhD Office and WCMC Office of Academic
	Affairs of return date to clerkship training
	Defend and submit thesis
CD6	return to Medical College, complete clerkship training
	(late November or early January)
	Complete clerkship training
CD7	Research and clinical electives
	Internship application (October 1)
	USMLE Step 2 (October – November)
	Internship interviews (December-January)
	Graduation (late May/early June)
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#### **DETAILED DESCRIPTION OF THE TRAINING PROGRAM**

**First Summer (First Rotation)** The Tri-Institutional MD-PhD Program requires as a condition of matriculation that new students arrive at the tri-institutional campus the first week in July (usually the first Monday after July 4). The students must return the Health Forms to the WCMC Student Health Services before their matriculation. At the time of matriculation, the program office must have received final, official transcripts from the undergraduate institution in which the student was enrolled, confirming that the anticipated course of study was completed and the appropriate degree was received.

All students begin their first research rotation at arrival. They are expected to have chosen their rotation laboratory before arriving. Accepted applicants visit laboratories they are considering for their first research rotation during the Revisit Day (in April). After the Revisit Day, the incoming students are encouraged to consult with the Program Director (and other faculty members) before they finalize their choice of rotation laboratory. Once the laboratory has been chosen, the program office should be informed of the choice (by June 1).

In addition to their laboratory research, the students take the *Responsible Conduct of Research* course that is given by the Program leadership. They also participate in a series of lunch discussions with clinician-scientists from the three institutions entitled *Careers in Biomedicine*, a joint course for first- and second-year students.

**First Academic Year (CD1)** In late August, the students begin their medical college education. MD-PhD students take all medical college courses plus three additional courses: *Frontiers in Biomedical Science I*, a research-article-based course that exposes the students to modern developments in biomedical research; *Introduction to Clinical and Translational Research*, a graduate-level course designed for MD-PhD students.

The Medical College curriculum is an amalgam of problem-based learning sessions, lectures, small- and large-group conferences, and labs. In the fall semester, students take *Essential Principles of Medicine*, which is composed of the following sequential learning units: *Pharmacology; Genetics* (including molecular biology); *Cells, Tissues and Control Systems* (cell biology and physiology, general pharmacology and early development); *Metabolism and Nutrition; Injury, Infection, Immunity & Repair*; and *Neoplasia*. Plus two semester-long learning units: *Anatomy*; and *Patient Care & Physicianship* (including public health, epidemiology, and biostatistics). In the spring semester, students begin taking the year-long *Health, Illness and Disease*, which is an system/organ-based physiology and pathophysiology course that cover the following topics: Cardiovascular System; Pulmonary System; Gastrointestinal System; Kidney; Endocrine System; Hematology-Oncology; Dermatology; Brain & Behavior; Musculoskeletal System & Rheumatology; Infectious Diseases. They also continue *Patient Care & Physicianship*.

In late July/early August, all students convene for the annual program retreat. The retreat is organized by MD-PhD students in CD3 and held either as a cruise-retreat or on the Tri-Institutional Campus. The retreat serves as a general scientific and social information exchange, and introduces the first-year students to their older peers and their research projects.

During the year, MD-PhD students should visit laboratories and decide where they will do their second research rotation (during the summer of CD1). Students should choose a laboratory in a different institution from where they were working during the first summer; if a student wishes to do the second rotation in the same institution where he/she did the first rotation, he/she must receive explicit approval from the Program Director – and will need to do three rotations (to satisfy the requirement that students rotate in laboratories in two different institutions). The students meet regularly one-on-one with Dr. Buck, and the Program Director and Dr. Buck meet

with the students, as a group, to discuss strategies for choosing a rotation laboratory. Then the students meet individually with the *Research Advisory Committee* to discuss their search for a rotation laboratory. The students are encouraged to consult with the Program Director before finalizing their decision.

**Summer after CD1 (Second Rotation)** The students devote this period to their second research rotation. They also participate in the *Careers in Biomedicine* lunch seminars.

Second Academic Year (CD2) The Medical College curriculum resumes in late August. Again, MD-PhD students take all medical college courses plus the MD-PhD course *Frontiers in Biomedical Science II*.

The Medical College courses are the continuations of *Health, Illness and Disease* and *Patient Care and Physicianship*, plus *Introduction to the Clerkships*, which includes BCLS certification.

MD-PhD students study for and take the United States Medical Licensure Examination (USMLE) Step 1 examination in January-February of CD2, before they begin their clerkship training (the clerkships are described on Pp. 9 – 10). MD-PhD students also will complete three required clerkship (chosen among Medicine, Surgery, Obstetrics and Gynecology, Pediatrics or Psychiatry), where one of the clerkships may be replaced by a four weeks Pathology elective.

During the year, MD-PhD students again visit laboratories to decide where to do their third research rotation (during the summer of CD2). The students also should begin to search for a thesis laboratory. The Program Director meets with the students, as a group, to discuss strategies for choosing a thesis laboratory. Then the students meet individually with the *Research Advisory Committee* to discuss their search for their rotation and their thesis laboratory. The students are encouraged to consult with the Program Director before finalizing their decisions.

**Summer after CD2 (Third, and maybe fourth, Rotation)** The students devote this period to their third research rotation. They should choose their thesis research laboratory by September 1. Students who would like to explore two laboratories before choosing their thesis laboratory can, with the approval of the Program Director, do two six-week rotations before choosing their thesis laboratory by September 30. Students who have identified their thesis laboratory during their first or second rotation may, with approval by the Program Director, begin their thesis research during the summer after CD2.

**The Research Years** MD-PhD students should have selected their thesis laboratory by September 1 of CD3. The primary institutional appointment of their thesis advisor determines the graduate school (GSK, RU or WCGS) in which the student enrolls. Except for students doing two research rotations during the summer of CD2, MD-PhD students must matriculate in one of the three graduate schools by September 1. It is important that the students complete the administrative requirements for matriculation as early as at all possible, so that they become aware of the current policies of their chosen graduate school. Also, a student's research account cannot be activated until the student has matriculated in a graduate school. The program office must be notified of the choice of thesis laboratory and graduate school.

Some students choose to do their thesis research under the guidance of two advisors. Any student who contemplates to do such a "joint thesis" should consult with the Program Director before going forward. If the two advisors are members of the same graduate school faculty, the student will formally have two advisors. If the advisors are members of different graduate school faculties, one of the advisors will need to be the primary advisor and the student should matriculate in that faculty member's graduate school.

**Change of thesis advisor** If an MD-PhD student finds that the thesis laboratory he/she chose does not provide the environment the student finds to be necessary to reach her/his goal, they may transfer to a different laboratory/advisor. Students can transfer thesis labs once, and should meet with the Program Director before initiating the transfer to discuss whether the situation can be resolved by other means. Students are not allowed more than one such transfer, unless they receive explicit approval from the Program Director, who will confer with the Program's Executive Committee (Appendix A) before making before approving (or disapproving) the change.

A major change in research focus, which will delay graduation, likewise requires the approval of the Program Director.

**Students who matriculate in WCGS** will need to enroll into the Graduate Program in which their thesis advisor is a member (there are no graduate programs at RU or GSK). If the thesis advisor is a member of more than one Graduate Program, the student can select the Program they wish to enroll in; *but they must enroll in a graduate program at the time of matriculation* into the graduate school. The Graduate Programs at WCGS are: Biochemistry & Structural Biology; Cell and Developmental Biology; Immunology and Microbial Pathogenesis; Molecular Biology; Neuroscience; Pharmacology; Physiology, Biophysics & Systems Biology. Students should consult the WCGS web page for more detailed information about the Programs and their course offerings, and should meet with the Graduate Program Director for their Program. Irrespective of the Graduate Program, the specific requirements for MD-PhD students will be those that pertain to all MD-PhD students, see P. 8.

MD-PhD students should select their Advisory Committee (AC) at GSK, Faculty Advisory Committee (FAC) at RU or Special Committee (SC) at WCGS no later than June 30 of CD3. These committees are an important complement, and counterbalance, to your advisor. Their function is to guide the students and evaluate their progress. The AC, FAC and SC each have three members. In addition to faculty from the graduate school in which the student is matriculated, **MD-PhD students should have a faculty member from another of the graduate schools (who is not a member of the graduate school in which the student is matriculated) on their committee.** The committee members should be chosen for their scientific expertise, in consultation with your thesis advisor; and the relevant graduate school office must approve the selection. The committee should meet at least once in every twelve-month period, usually during the month of October.

**Committee Meetings** MD-PhD students have two committee meetings per year in Years 4+; the committee may decide to waive the second meeting of the year if it is deemed that the student is making solid progress. (Students who change thesis laboratory are required to have two committee meetings per year for the duration of their research training.) Students are responsible for scheduling their committee meetings and for informing the Program Office that the meeting has taken place. It is the policy of the MD-PhD Program that students in CD4+, who fail to convene their committee meeting by December 31 and June 30 of the academic year, will be considered to be in poor academic standing—unless they have received explicit permission to have the meeting at a later date (or the second meeting has been waived by the committee). All students therefore are encouraged to make sure that their committee meetings occur in a timely manner, and that the reports are submitted to meet this deadline. Given the difficulties associated with coordinating the calendars of busy people, students are advised to begin scheduling the committee meetings several months in advance—and to send out reminders!

Research proceeds at an unpredictable pace, which often is slower than the students' (and their advisors') expectations. The committee meetings therefore are important, as they provide for periodic assessments of the progress by people outside the laboratory. The meeting in the middle

of CD5, after two years of laboratory research, is particularly important because the overall scope of the thesis research should begin to materialize by this time. If the student, or her/his committee, is concerned about the rate of progress, the committee meetings may be scheduled more often than twice a year, so that the rate of progress can be monitored more closely. The decision whether the student can defend her/his thesis in CD6 usually is made in the meeting in the middle of CD5 (sometimes at a later meeting at the end of CD5/beginning of CD6). If a student is concerned about her/his progress, the Program Director should be invited to that meeting. In any case, if it is decided to extend the thesis research an additional year, the program office must be informed.

Students may propose changes in the committee composition as their research interests evolve. Any such changes must be approved by the relevant graduate school office.

**Graduate School Requirements** The graduate school requirements are comparable for MD-PhD students, irrespective of the graduate school they are matriculated in (or graduate program their thesis advisor is associated with). Students in any graduate school must complete satisfactorily the equivalent of four graduate school course units (a course unit is, approximately, a quarter-long course)—in addition to the Frontiers courses and Introduction to Clinical and Translational Research. MD-PhD students usually take advanced level courses, chosen in consultation with the thesis advisor. All graduate courses at GSK, RU and WCGS are open for MD-PhD students without regard to the graduate school in which they matriculate. It is expected that the students complete their course requirements by June 30 of CD3. (Exceptions will be made if a student wishes to take a regularly scheduled course that was not offered during the student's first research year.) If they so wish, students in CD4 and beyond are free to take additional courses. Students who do so usually audit any such courses.

If a student and her/his advisor find that the student's progress in her/his thesis research depends on the student taking graduate courses outside GSK, RU or WCGS, the student should discuss the situation with the relevant graduate school dean.

No later than August 31 of CD4 (October 31 of CD4 for students at GSK), the students must submit a thesis research proposal, which should be presented/defended at a meeting of their AC (at GSK), FAC (at RU) or SC (at WCGS) no later than October 31 of CD4 (December 31 of CD4 for students at GSK)—at which point they are free to concentrate fully on their thesis research. The format for the thesis research proposal is given in Appendix C.

Though not a formal graduate school requirement, MD-PhD students are expected to write an application for independent fellowship support based on their thesis research proposal (and the feedback the students receive at the presentation/defense of their proposal).

**Clinical Electives** In addition to their thesis research, students in CD4 and beyond are encouraged to participate in part-time Clinical Electives, where they for a brief period follow a WCMC faculty member on a clinical service at Hospital for Special Surgery, Memorial Hospital, or NewYork Presbyterian Hospital. This will help students gain familiarity with clinical specialties they may be considering for post-graduate clinical residency training. Please note, however, that MD-PhD students are covered for malpractice insurance only if they work under the direct supervision of a WCMC member.

**Defense of Thesis** To graduate from the program in seven years, students should complete their thesis research, write, defend and submit their thesis no later than February of CD6. The program strongly recommends that students defend in the Fall of CD6, in order to have sufficient time to explore clinical career options.

The relevant graduate school offices should be consulted for the format for the preparation,

submission and defense of the research thesis. All students must submit the final, approved version of their thesis to the appropriate graduate school 60 days after the defense of the thesis – **before** returning to their clinical training. Given the intensity of the clinical training, thesis corrections and revisions are not possible after the return to the clinic.

It is expected that MD-PhD students have submitted original research articles of which they are first author by the time they defend their thesis. It is advised that all research articles relating to the thesis research be submitted before the students begin their clinical training.

**Final Clinical Training** MD-PhD students must complete 54 weeks of required clinical clerkships, including the 14 – 18 weeks of clerkship training in CD2 (depending on whether or not you take the Pathology elective). The required clerkships are: Anesthesia and Critical Care (4 weeks, including a two-week refresher in history taking and physical diagnosis); Medicine (8 weeks); Neurology (4 weeks); Obstetrics and Gynecology (6 weeks); Pediatrics and Adolescent Medicine (6 weeks); Primary Care (6 weeks); Psychiatry (6 weeks); Public Health Systems (2 weeks); Sub-Internship (4 weeks); and Surgery (8 weeks).

MD-PhD students should aim to return to complete their clinical training In December of January of the penultimate year of training, which ensures that they begin their training together with the second-year medical students. If a student wishes to begin her/his final clerkship at a different time, he/she must have approval from the Program Director before contacting the Office of Academic Affairs at WCMC.

Students who return in December-January are able to complete their remaining 36 - 40 weeks of required clerkship training by November of their graduation year, giving them plenty of time for research and clinical electives — and their residency interviews. To help students to structure their final year of training, the students submit a written plan for the year, which they discuss with the Program Director.

The order of the clerkships is determined by lottery, which considers the particular constraints that apply to MD-PhD students. In March of their penultimate year of training, MD-PhD students participate in the regular clerkship lottery.

With permission, and at least 30 days' advance notice, students may be able to change the order of their clerkships. The relevant clerkship director(s) and the WCMC Office of Academic Affairs grant the permission. This 30-day advance notification requirement also applies if a student finds that he/she must postpone her/his thesis defense (and return to the clinical training). If a student does not give at least 30 days advance notification to the Medical College's Registrar's Office and the Program Office that he/she will not return as scheduled, the student will have to complete the clerkship he/she was signed up for.

MD-PhD students will receive information about the clerkships before the lottery (in the studentorganized Discussion Group on Clinical Clerkships and Residency Programs, see P. 12, and in meetings organized by the WCMC Office of Academic Affairs). All MD-PhD students who plan to defend their thesis in the upcoming academic year should inform the MD-PhD Program Office and the Office of Academic Affairs at WCMC no later than January 31.

**Planning for the Return to the Clerkships** As MD-PhD students plan their final year in the laboratory – and schedule their thesis defense and return date – they need to be aware of several important issues:

1. Due to the organization of the clinical training, MD-PhD students may have not completed their clerkships when they apply, and interview, for post-graduate clinical training positions. Be sure to schedule your clerkships such that you have completed the

expected clerkships (Medicine and Surgery plus clerkships or electives in your chosen specialty) before you apply for postgraduate training.

- 2. It can take several weeks (even a month) for grades to be issued after a clerkship is completed. If you plan to participate in the National Resident Matching Program, the Main Match, any clerkship that you want to be considered in your application (and listed in your transcript) must be completed by September. This cutoff is even earlier for the Early Match residencies (see above), where the application usually is due in August.
- 3. It is becoming increasingly difficult to take time off from a clerkship to interview and revisit the training programs you have applied to. Strive to complete your clinical training by December 1 of your final year of training.

Finally, please note that the formal requirements for graduation for MD-PhD students differ from those for MD students. MD-PhD students are required to complete only the clerkships listed above, and are not required to do electives. Also, based on their having completed satisfactorily their thesis research, MD-PhD students get credit for the Area of Concentration (AoC) requirement that MD students must satisfy.

## SPECIAL COURSES OF INSTRUCTION AND TEACHING OPPORTUNITIES

The information below is for the MD-PhD student-specific courses mentioned above.

The WCMC course descriptions can be found at: http://www.med.cornell.edu/education/curriculum/

The GSK course descriptions can be found at: <a href="http://www.sloankettering.edu/curriculum/">http://www.sloankettering.edu/curriculum/</a>

The RU course descriptions can be found at: http://www.rockefeller.edu/graduate/curriculum

The WCGS course descriptions can be found at: http://weill.cornell.edu/gradschool/courses/index.html

*Careers in Biomedicine* (Summer before CD1, Summer of CD1) Twice-a-week lunch discussions that introduce incoming MD-PhD students and first-rear students to clinician-scientists at the three institutions. Most faculty presenters are young investigators, who combine research and clinical responsibilities at some level and thus serve as role models. The speakers rotate over a three-to-four year cycle. Course director: J. Buck, MD, PhD.

**Responsible Conduct of Research** (Summer before CD1 and during CD5) The aims of the course are: to heighten the students awareness of ethical considerations relevant to the conduct of research; to inform about applicable federal, state, and institutional policies; and to provide an opportunity to discuss the implications of these policies with senior faculty. The schedule varies from year to year. Per NIH policy, students who are supported by federal training grants (whether individual or institutional) must take the course every four years.

*Frontiers in Biomedical Science* I: *Critical Reading of Scientific Literature* (CD1) The aim of this course is to present modern biomedical research at an advanced level. The course is taught at WCMC and is organized by a Tri-Institutional faculty group. The organizing faculty members are appointed by the Program Director with input from the institutions. Course director: J. Buck, MD, PhD.

With permission of the Program Director, the course is open to a limited number of MD students, with preference given to students who are considering applying for transfer to the MD-PhD Program.

The course covers the following topics: quantitative biology (including biophysics, structural and systems biology); cell biology; signal transduction; and genes and development. The course is a structured journal club, which is described in more detail in Appendix D.

Students must pass the course (Pass/Fail grading) in order to advance to CD2. Any student who participates in less than 80% of the sessions will receive a Fail. As a make-up, the student must write a five-to-ten page review paper on a topic that was covered in a session the student did not attend.

To address the diverse expertise among the incoming students, and to introduce the incoming students to the members of the *Research Advisory Committee*, the course is preceded by sessions given by the members of the committee.

*Introduction to Clinical and Translational Research* The aim of this course, which is required of first-year MD-PhD students but open to all students in the program, is to introduce students to the excitement of clinical and translational research. The course covers concepts related to clinical trials, IRB, data safety monitoring, IND, NDA, federal regulations as well as intellectual property issues. In addition, six faculty members (two from each institution) describe their own work with special consideration of the unique aspects of international, pediatric and HIV clinical trials. Course director, J. Buck, MD, PhD.

*Frontiers in Biomedical Science* II: *Introduction to Molecular Medicine* (CD2) This course is also taught at WCMC. It covers the following topics: pharmacology; neuroscience; cancer; endocrinology; immunology/microbiology. The course is organized, structured and graded in the same manner as Frontiers in Biomedical Science I. Students must pass the course in order to advance to the research years. Course director: J. Buck, MD, PhD.

*Clinical and Research Genomics with Next-Generation Sequencing* (any year) This elective course aims to provide the students with an understanding of the complexity of the human genome, which is essential for proper annotation and characterization of any new mutations/modifications found using modern (Next-Generation) sequence methods. Students will develop a strong foundation of knowledge of NGS technologies (both existing and emerging), learn the applications of these technologies for basic and clinical research, and finally learn the essential tools for the analysis, integration, and application of these data relative to other public databases and phenotype repositories, in order to understand how tumor and normal genome sequencing have dramatically altered our view of the "normal" genome and epigenome, and how this has altered our approach to patient care. Course Director: C. Mason, PhD.

*Case Discussion Rounds* Bi-weekly presentations of case studies to provide instruction in clinical reasoning for MD-PhD students during their research training. The goal is to provide the students instruction in clinical reasoning and thus help them maintain familiarity with clinical medicine during their research training. One student presents a clinical case, usually based on the Clinicopathological Conference from the Massachusetts General Hospital, to the participating students who have no prior knowledge about the case. The group discusses the key findings, to decipher the etiology and the underlying mechanisms. Course director: M. S. Pecker, MD.

**Clinical Electives** Individualized, short-term exposures to clinical medicine in the student's area of interest. Clinical tutors are identified by the student, with assistance by the Career Counseling Committee. The students accompany the tutor on rounds, in the clinic, or in some other appropriate clinical activity. "Shadowing" an attendant on the consult service in the student's field of interest is a particularly effective way to learn about that specialty. The aim is to provide career guidance with minimal impact on the students' time management. There is no fixed number of electives, and MD-PhD students should not explore clinical career options until their thesis research is well underway (in CD4 and beyond).

*Teaching Opportunities* MD-PhD students may be involved, on an elective basis, in several teaching initiatives. The aim is to provide students with teaching experience with minimal disruption of their other activities; the students' time commitment is limited. The following opportunities are available:

- 1. Students in their research years can be journal club facilitators for journal clubs in the firstand second-year medical college curriculum.
- 2. Students in all years organize and tutor the journal clubs for the MD-PhD Program's Gateways to the Laboratory Program for underrepresented minority students, as well as other initiatives, such as the Basic Laboratory Skills Workshop and Clinical Skills Workshop.

## STUDENT-INITIATED ACTIVITIES

**Female Association for Clinicians, Educators, and Scientists (FACES)** FACES is a unique organization that strives to bring together women from the Tri-Institutional area. It was founded in 2003 by the incoming women of the MD-PhD class together with Debra G. Leonard, MD, PhD, at the time Vice-Chair of Clinical Pathology at WCMC. Since its inception, FACES has become an invaluable forum for students and faculty members alike. The organization provides a mechanism for women of all ages and stages in their careers to connect and share advice on topics relevant to women in academia.

**Work-In-Progress Sessions and Journal Clubs** Over the years, MD-PhD students have organized Tri-Institutional work-in-progress sessions, where students in their research years present their work, and a number of focus-group journal clubs have been organized, such as in Immunology and Cell Biology. The program office supports these activities by providing funds for light refreshments.

**Annual Barbecue** The first-year students are welcomed to the program at a barbecue in early July. Students from all years, program faculty, and administration attend the barbecue.

**Annual Retreat** The retreat is in mid-August, before the medical college's orientation for the incoming students. It is organized by the third-year students with logistic support from the program office. The purpose of the retreat is general information exchange, where students from all years give brief presentations of their rotation or thesis research and discuss common concerns. The retreat also introduces the first-year students to their older peers. Recent graduates of the program are invited to come and talk about their post-graduate experiences. The retreat therefore is an important element of the training program and attendance is mandatory. Students in their final clinical training are excused from clinical responsibilities during off-campus retreat. If a student for some reason is unable to participate, he/she must notify the program office and request approval for an exemption.

**Discussion Group on Clinical Clerkships and Residency Programs** MD-PhD students in their final year organize sessions for all interested MD-PhD students in early January and in late March/early April, where graduating students share their experiences on how to schedule clerkships and how to choose and to apply for residency programs. The program office provides refreshments and logistic support.

**Du Vigneaud Symposium** Organized by PhD students at WCGS, who for many years have convened a day-long symposium in early May, where they present their research in oral and poster presentations. All MD-PhD students, including those doing their thesis research at RU and GSK, and their faculty advisors are invited to participate.

**Rockefeller Graduate Students' Retreat** Organized by PhD students at RU. Takes place September.

Admissions and Recruitment MD-PhD students participate in the recruitment of new students into the program during the Interview Days (in October and November) and the Revisit Day for accepted applicants, where students in CD1 and CD2 organize "get acquainted with NYC" activities.

**Class Dinners** The program office provides support (\$ 15/student) for two dinners per year for each MD-PhD class (one per semester, at least four months apart). Upon request (and approval) these funds can be used for other class-wide activities.

## GUIDANCE AND COUNSELING OF MD-PHD STUDENTS

The MD-PhD Program devotes considerable effort to advise and guide students in the selection of laboratories for their rotations and thesis research. To ensure that the students have a reliable, consistent source of academic advice, two MD-PhD Program committees, the *Research Advisory Committee* and the *Career Counseling Committee* provide the MD-PhD Program-specific academic and career advisory functions. The two committees have overlapping membership, but different functions, as described below. Three key faculty members, who serve on both committees and who have accepted responsibility for tracking and advising MD-PhD students, are (contact information on P. ii): Hugh C. Hemmings, MD, PhD, at WCMC; Ross L. Levine, MD, at SKI; and Sohail Tavazoie, MD, PhD, at RU.

The program office, which is managed by Ruth Gotian and staffed by Caroline Fulford, Renee Horton, and Hanna Silvast, generally should be the starting point for all information gathering by MD-PhD students—in particular for students in their early years in the program.

The program's administrative director has extensive experience in dealing with day-to-day issues and acts as an effective liaison between the medical college and the three graduate schools. The administrative director will be able to advise students about the proper contact people, who are experienced with program issues and the policies and traditions in each of the three institutions. Questions relating to academic guidance usually are referred to the Program Director or one of the faculty advisors listed above. Also after the students have matriculated in one of the graduate schools, they should remain in close contact with the program office, as this will facilitate a smooth transition back to the clinical training. During the graduate school years, MD-PhD students have added responsibilities because they must abide by the policies of their respective graduate school, keep in touch with their graduate Program Director or dean's office, while keeping the MD-PhD Program office in the information loop.

In addition to these formal mechanisms, MD-PhD students are encouraged to consult with their laboratory research advisors and student advisors; but these individuals may be less familiar with the intricacies of the program than those identified above.

Finally, the Program Director has weekly office hours (Wednesdays 5 to 7 pm), where he is available to discuss student concerns, academic or otherwise. Problems usually can be addressed most effectively if the program is informed early, and MD-PhD students should feel free to come directly to the Program Director if a serious problem of any nature arises. (It is recommended, however, that students reserve a time slot (with Caroline Fulford, Renee Horton or Hanna Silvast at 746-6023), as there usually are several students who wish to meet with the Program Director.)

**Guidance on the Selection of Rotation and Thesis Laboratories** The *Research Advisory Committee* provides advice and guidance during the first two years of medical college training. The committee meets with the incoming students in July to welcome them to the campus and to introduce the academic and research opportunities available. The committee meets with each student again in late January/early February to help each student in her/his search for the next rotation laboratory. Before these meetings, the Program Director and Dr. Buck meet with the students, as a group, to discuss strategies for choosing a rotation laboratory. The students are advised to bring a list of tentative laboratory choices to their meeting with the *Research Advisory Committee*. The committee will help the student narrow down the list and, for students who have not yet chosen a laboratory, identify suitable laboratories in each of the three institutions based on the students' research interests and preferred type of laboratory environment.

All students should inform the program office when they have chosen a rotation laboratory. A student who has not done so by mid-April will be asked to meet with the Program Director.

Students who have not decided on a thesis laboratory by late July of CD2 should meet with the Program Director to discuss their options.

In late August of CD2, when the students have chosen their thesis laboratories, the MD-PhD Program office informs the three graduate schools about the students' choice of thesis advisors. For students who matriculate in WCGS, the graduate school office will inform the appropriate graduate Program Director that an MD-PhD student has enrolled into their program.

#### Things to remember when you search for a rotation or thesis laboratory:

- 1. Your experience will be different from that of the student who came before you—and the student who will come after you.
- 2. Explore the laboratory in person, by participating in lab meetings, before committing.
- 3. Do not expect to accomplish much in your rotation research; therefore, select a laboratory in which you will work on something the laboratory is known for—so that you learn the methods (but be an active participant in the exchange of new ideas).
- 4. When searching for a thesis lab, you really are searching for a thesis project. Your eventual decision should be based on the quality of the research project you will work on and the mentoring you will receive.
- 5. If you have an idea for a great research project that does not fit well within any single laboratory; you should consider whether it possible to work on this project by combining the expertise of two laboratories with complementary skills. Students before you have done so; but it is a challenge, and you should discuss the issues involved with the Program Director before finalizing your plans!

**Guidance in the Conduct of Graduate Studies and Career Counseling** The dean of the graduate school in which the student is matriculated is responsible for monitoring the student's performance during the research years. If an MD-PhD student is perceived to be in (academic) difficulties, the dean will consult with the Program Director.

To address the special needs of MD-PhD students, the *Career Counseling Committee* follows the students' progress through their research years. The Committee meets with the student in the beginning of CD4 to monitor their progress and discuss their clinical interests. The Committee will help the students identify clinical faculty members who can serve as tutors (role models/advisors) in clinical electives. The next meeting is December/January of CD5, where post-graduate training is the major focus. The Committee members provide information about training programs and application strategies. Students are encouraged to search out alumni of the program for additional information (about the alumni's own training experience and their knowledge of other institutions).

## **PROFESSIONAL CONDUCT**

As MD-PhD students you are entering a profession, and you will from your first day in the program be regarded as junior members of that profession. You should behave accordingly. The term *Professional Conduct* has many implications, and all students should familiarize themselves with the Code of Professional Conduct in the institution in which they matriculated.

The aim of the code is to foster an atmosphere of academic and professional integrity, in which each individual accepts responsibility for her/his behavior. The code establishes norms that will guide you as you struggle with the, at times difficult, moral and ethical questions that will arise in your career as a biomedical investigator. The nature of the questions that arise will change over time, as will your own appreciation of the issues involved; but the basic principles will remain invariant.

Some norms are self-evident, such as the absolute prohibition against plagiarism and other scientific misconduct. Other norms are more subtle, such as those pertaining to your interactions with your colleagues, advisors and other faculty, and eventually your patients. This involves three related issues: how you behave; how you communicate; and how you treat the information you receive.

- You are in training to become a physician-scientist, which means that you will have clinical responsibilities—at least while you are completing your clinical training in the medical college. You will be responsible for your patients' lives and well-being, which means that you must have the competencies needed to practice your chosen profession. You also have special responsibilities in terms of how you behave toward your patients—you show compassion and respect. Your interactions with colleagues and faculty should be at the same high level.
- Science progresses because scientists exchange information, and it is important that you communicate accurately, effectively and with appropriate consideration for the people you communicate with. This requirement goes beyond the mere exchange of scientific information; it applies to all your professional interactions—including those pertaining to your medical education and clinical activities—from your first day in the program.
- You will be the beneficiary of confidential information: fellow students will discuss their newest results and you will exchange information about different laboratories; at lab meetings you learn about your colleagues' exciting results; you read their grant applications and manuscripts; and you will be given manuscripts to review for journals. Later, your patients will trust their secrets to you. Some of the information that comes your way can be disseminated freely; but much of the information is privileged, meaning that it can be disseminated only with the explicit approval of the individuals who gave you the information. If you are in doubt whether some information is privileged, you should assume it to be so until you have permission to discuss it with others. Breaches of confidentiality are serious violations of professional conduct. You need to use your judgment—at all times!

This combination of competency, honesty and confidentiality is the hallmark of professional integrity.

Finally, as MD-PhD student you have many privileges. These privileges are not entitlements; you have to earn them—by performing at a consistently high level. Noblesse oblige!

## **EVALUATIONS**

#### FACULTY EVALUATION OF STUDENT PERFORMANCE

*Committee on Promotion and Graduation* During their medical college education and training (CD1, CD2, and the final two years of clinical training), MD-PhD students are subject to the policies pertaining to WCMC MD students regarding academic and professional conduct. The responsibility for evaluating student performance rests with the Senior Associate Dean (Education) at WCMC. The grades and descriptive précis submitted by each course or clerkship director after the completion of each course or clerkship are reviewed by the Committee on Promotion and Graduation, which is chaired by the Senior Associate Dean (Education). The MD-PhD Program Director is an *ex officio* member of the Committee. The Committee's certification that all courses have been passed is needed before a student can advance to the next academic year or to graduation.

*Laboratory Research Rotation Advisors* The research advisors submit written reports on the students' performance during each of the three research rotations. The reports are forwarded to the MD-PhD Program office, which will send a copy of all evaluations to the graduate school in which the student matriculates. The evaluation form is reproduced in Appendix E1.

*Research Advisory Committee* and *Career Counseling Committee* A brief synopsis of student performances is prepared after each meeting.

*Special* or *Faculty Advisory Committees* Each student's Advisory Committee (AC, GSK), Faculty Advisory Committee (FAC, RU), or Special Committee (SC, WCGS) meets at least annually to evaluate the student's academic progress. Written reports are forwarded to the dean of the respective graduate school office. In case difficulties are perceived, the dean will confer with the MD-PhD Program Director.

*Defense of Thesis Research Proposal* No later than October 31 of CD4, the AC (at GSK), the SC (at WCGS), augmented with one additional WCGS member who serves as chair, or the FAC (at RU) evaluate whether the student has mastered her/his research area and is ready to proceed officially to "independent" thesis research. (The student's written thesis research proposal should be submitted to the respective committee, with copies to the graduate school office and the MD-PhD Program office, no later than August 31 of CD4.) The Committee's evaluation is forwarded to the relevant graduate school office (and the MD-PhD office).

*Thesis Committee* The AC (GSK), the FAC (at RU), augmented with one external reviewer, or the SC (at WCGS), augmented with one additional WCGS member who serves as chair, reads the thesis, attends a public presentation by the degree candidate, and administers an oral examination on the subject matter presented. The committee's recommendation to the dean is necessary for the acceptance of the thesis in partial fulfillment of the requirements for the PhD degree.

*MD-PhD students who tutor Journal Clubs* The tutors' performance is evaluated by the same mechanism that first- and second-CDMD students evaluate all their courses and course components. The MD-PhD student tutors receive a copy of the evaluation, and they are encouraged to discuss any questions they may have regarding their evaluations with the associate dean for curricular affairs at WCMC.

#### Student Guide to the Tri-Institutional MD-PhD Program

#### STUDENT EVALUATIONS OF FACULTY PERFORMANCE

*Rotation Laboratory* Each MD-PhD student fills out questionnaires prepared with input from the student representatives of the program's advisory committee (see Appendix E3). The questionnaires are reviewed by the Program Director, the associate directors and the administrative director and filed in the program office. Given that the identity of the students who submit the forms will be known to anybody who reads them, these forms are confidential information. ANY breach of this confidentiality will be considered a breach of the Code of Professional Conduct.

*Frontiers of Biomedical Science* (CD1 and CD2) Each MD-PhD student fills out questionnaires prepared by the MD-PhD Program office (see Appendix E2). (If the students prefer to do so, they may fill out a common evaluation.) The questionnaires and analyses are reviewed by the program's executive committee, and shared with the course leadership. Where appropriate, the courses are adjusted in format, subject matter, and choice of instructors in response to the students' comments.

*Medical College Curriculum* (CD1 and CD2) In the same manner, each MD-PhD student fills out a questionnaire about other courses (the questionnaire is that used by all WCMC MD students). The questionnaires and the analyses are reviewed by the medical college's office of curriculum and educational development.

# TRANSITIONS

#### MATRICULATION INTO THE MD-PHD PROGRAM

Are MD-PhD students MD or PhD students? They are both — at all times. You will work in the laboratory; you also will be in the classroom during the first two years of medical college training. You will be co-mingled with a class of MD students; *become a full-fledged member of that class*—if for no other reason than that your classmates will be your residents during your clerkship training. Do not forget that you are the beneficiary of many privileges, which means that you are held to a high(er) standard. Though the laboratory is exciting, and may be your eventual calling, in the medical college you are training to become a physician—to take care of patients. Act accordingly! You will approach the material with a more questioning attitude than many MD students would; but you should not go overboard doing so. As a physician-scientist you are expected to be skeptical of authority—and yet to function well within the medical profession, which as other professions has a well-developed hierarchy (and you are at the bottom of the totem pole). Finally, as MD-PhD students your training involves a series of transitions that set you apart from both MD and PhD students. Your fellow, MD or PhD, students will not always understand the stresses these transitions create; the program leadership does.

#### FROM MEDICAL COLLEGE TO GRADUATE SCHOOL

The transition from the medical college to the graduate school is stressful. First, you must decide on a thesis laboratory. Second, medical college is predictable and life is structured by the curricular demands. Laboratory research is not predictable and less structured. You must identify a suitable thesis project, which despite the best planning may turn out to be a dead end or cause unexpected difficulties. You will worry about how you will "fit" into the laboratory: will you get along with your advisor; will your thesis project continue to excite you? These concerns are common for all MD-PhD students. Relax, even though the concerns are real, they are manageable—and your predecessors in the program have managed them successfully!

#### FROM GRADUATE SCHOOL BACK TO MEDICAL COLLEGE

The transition from graduate school back to the medical college also causes stress. You leave the relative freedom of the laboratory for the structure of the clerkship, where you are part of a team and your activities will be dictated by your responsibilities for your patients. It is difficult to make the transition from being a recognized expert in your field of research to a (somewhat unprepared) MD student. You have been away from the medical college for 3½ years, or more, and now you will be responsible for human life! Yes, in the first few weeks you will not know as much as the third-year MD students in your clerkship group—and, to make matters worse, you will not even know your fellow students as you usually will be the sole MD-PhD student on the team. But you may know the residents, as classmates from your first two years of medical college education. In any case, you will catch up fast! Do not underestimate the impact of what you have learned during your thesis research. You have gotten a thorough training in basic biological mechanisms. You also are trained to digest large amounts of material, to formulate working hypotheses, and to plan and execute the experiments that will allow you to test your hypotheses. These same skills are invaluable in the clinical setting – and you will find that you remember more of the medical college curriculum than you thought you did.

The clerkship lottery is sufficiently flexible that you, subject to the time available, will be able to explore your major clinical interests. Start out with a clerkship in an area that is peripheral to your future career plans—if possible, a 12-week clerkship; but you should do your chosen clerkship (or clerkships) early, so that you are informed about the field that you intend to enter. This also will enable you to participate in off-site electives—if you return in January, or earlier.

In the clinic, live by the following six rules:

- 1. Live on the wards (as you lived in the lab)
- 2. Be a full-fledged member of your house-staff team
- 3. Be interested (or try to be) in everything that you are doing
- 4. Take notes; details are important and you need to be organized
- 5. Take good care of your patients; you are responsible for them
- 6. Read—constantly

#### FROM MEDICAL COLLEGE TO POSTGRADUATE CLINICAL TRAINING

The search for internship and residency programs is another period of stress. You apply when you have been through only a fraction of your clerkships, and you may be uncertain about your goals. The decisions you make are important; but relax (a little)—medicine and biomedical research are changing rapidly, and nobody can plan for more than three years, or so, into the future. So, the only thing that matters is to avoid bad decisions; you will have to "close the door" on a number of career options, but try to maintain as much flexibility as possible. And remember, you cannot do the "control experiment"—don't look back!

Keep in mind that postgraduate clinical training programs are looking for clinicians, people who take good care of patients. That you are trained in research is a plus; but no amount of research training (or publications) will make up for a poor record in your medical college training! Grades matter, and it is important to "make a good impression"—as a future physician.

The Dean's Letter, which is being sent to all postgraduate training programs that you apply to, is important because it summarizes your standing as a MD student. The letter is mailed at After October 1 of your final year in the program. You should review your Dean's Letter when you are notified that it is ready, and you should feel free to identify omissions/inaccuracies before it is mailed out. The WCMC Office of Academic Affairs may not be aware of all you have done as an MD-PhD student. The MD-PhD Program office provides a summary of your contributions to the Office of Academic Affairs; but it is your responsibility to make sure the relevant information is being provided in the Dean's Letter. An equally important letter is the Chairman's Letter from the WCMC academic department in your field of clinical interest.

You will apply and be interviewing while you are in your clerkships. Write your applications early, during your one-week vacations in April and June after you begin your clerkships (you can revise them in September-October, when you career plans have become better defined). Do not schedule too strenuous clerkships during the interview period. **Do not schedule subinternships during the interview period** (December-January). Most clerkship directors allow students time off for interviews; usually five days total, including travel time. When you have been invited to an interview, contact the clerkship director to **request** time off for the interview (including travel time).

During your clerkships you will receive detailed information about your options for postgraduate clinical training. The MD-PhD Program also keeps a binder describing research residencies that we have information about. The binder content is updated as new information comes in.

The requirements for board certification vary among specialties, and are regularly revised. You need to know the current requirements for specialties that you are considering. You will find much useful information in K. V. Iserson. *Iserson's Getting into a Residency: A Guide for Medical Students*, 8<sup>th</sup> Ed. Galen Press, Ltd., 2013; and *Graduate Medical Education Directory*, updated annually by AMA <a href="https://catalog.ama-assn.org/Catalog/">https://catalog.ama-assn.org/Catalog/</a>. You also should consult <a href="https://www.ama-assn.org/ama/pub/education-careers/graduate-medical-education/freida-online.shtml">https://www.ama-assn.org/ama/pub/education-careers/graduate-medical-education/freida-online.shtml</a>.

## LIFE AFTER THE MD-PHD, MEDICAL LICENSURE, CAREER PATHS

The mission of the MD-PhD Program is to educate and train physician-scientists, who can bridge the (widening) gap between clinical medicine and laboratory research, which is brought about by technological developments and specialization in both fields.

The mission of the physician-scientist is to promote better health and enhance the quality of life by reducing morbidity and mortality from disease through the advancement of basic and clinical science and education.

The MD-PhD training, however, does not make you a scientist or a physician; it gives you the skills and credentials to pursue a career in biomedicine, broadly defined. Just as any other PhD, you may need to do post-doctoral research training in order to become a scientist who can compete successfully for grant support. Similarly, like any other MD, you need to complete your post-graduate clinical training before you can be a (licensed, Board-certified) clinician.

#### MEDICAL LICENSURE, USMLE

It is a requirement for medical licensure that you complete the three steps of the United States Medical Licensing Examination (USMLE); detailed information about the USMLE is found at <a href="http://www.usmle.org/">http://www.usmle.org/</a>.

In addition to its importance for medical licensure, USMLE Step 1 has become increasingly important as a screening tool used by residency programs. It is important to do well, where doing well depends on how competitive your chosen field is. If you believe (or are told) your Step 1 score may limit your residency choices, you should begin your clerkship training so early that you can take Step 2 (and do well) and have your Step 2 scores be available when you apply for post-graduate training.

**Step 1** is taken toward the end of CD2—in May, before you begin Introduction to Medicine for Clinical Investigators. If you anticipate difficulties meeting this deadline, you must meet with the Program Director. If you have not received a passing score by November 1 of CD3, you will no longer be in good academic standing!

**Step 2**, which is administered in two parts (**Clinical Knowledge**, **CK**, and **Clinical Skills**, **CS**), is taken during the final year of your clerkship training; the timing for taking these tests depends on the USMLE Step 2 requirements of the programs you apply to. An increasing number of training programs require Step 2 scores before ranking their applicants for the residency match; some programs may relax this requirement for MD-PhD students (and some programs waive the requirement for students who have high Step 1 scores), you will need to contact each training program you plan to apply to determine their requirements regarding USMLE scores. Seats for the Step 2 CS test are limited, and you need to plan ahead; the schedule for reporting Step 2 CS scores can be found at <a href="http://www.usmle.org/step-2-cs/#reporting">http://www.usmle.org/step-2-cs/#reporting</a>.

Scheduling the Step 2 tests depends on how well you did on Step 1; the better you did, the later you can take Step 2. The decision will be different for each student, and will be determined by three factors: when you returned to the clerkships (when you are ready to take the test); how well you did on Step 1 (would your application be strengthened by your Step 2 performance); and the requirements of the post-graduate training programs you plan to apply to. As a general rule, Step 2 CK and CS should be taken no later than November 30 of the academic year you graduate.

Step 3 is taken during your post-graduate clinical training.

#### Student Guide to the Tri-Institutional MD-PhD Program

Medical licensure is administered by each state's Medical Board, and the requirements for licensure vary from state to state. Overall USMLE policies are set by the USMLE Composite Committee, which is composed of representatives from the Federation of State Medical Boards (FSMB), the National Board of Medical Examiners (NBME), and the Educational Commission for Foreign Medical Graduates (ECFMG). You should be aware that the Composite Committee recommends a general time limit of seven years for the completion of the three steps in the USMLE. The USMLE Composite Committee has recommended that the Seven-Year Rule be relaxed for MD-PhDs, <a href="http://www.fsmb.org/usmle\_updates-md-phd.html">http://www.fsmb.org/usmle\_updates-md-phd.html</a>, but it is a recommendation only—and some states implement this Seven-Year Rule rigorously while other states are more lenient, see <a href="http://www.fsmb.org/usmle\_eliinitial.html">http://www.fsmb.org/usmle\_eliinitial.html</a>. You need to be aware of the different states' requirements when you apply to postgraduate training programs—and the USMLE Seven-Year Rule is a very good incentive for aiming to graduate in seven years.

#### CAREER PATHS OF MD-PHDS

Apart from the USMLE requirements, the world is your sandbox. The figure below summarizes the main MD-PhD career paths. You can combine the various options in different ways; but it is difficult to excel in more than two activities – at any one time.

The transition from your post-doctoral clinical/fellowship training to your first independent faculty position, and the next few years, will be a particularly stressful period. Be sure that you have the fellowship training that will be needed to establish an independent clinical research program. Nobody can stay in training forever, and you will be burning to get a "real" job; but the methods you mastered in during your thesis research are likely to have become obsolete, so you cannot skimp on your fellowship training—which is another, good reason for graduating from the program in seven years.



#### FINALLY:

As an MD-PhD you can become (almost) anything you want to be; *but someday you have to make a decision*!

Biomedical research is changing at a rapid pace; you have got to adapt – and be ready to make new decisions!

In life you cannot do the control experiment; there are many right decisions; you need to avoid the wrong ones!

NOBODY remembers what your thesis research was about; *it is the <u>training</u> and <u>mentoring</u> that is important*!

## ADMINISTRATIVE ISSUES

# **MD-PHD STUDENTS ARE SUBJECT TO THE POLICIES OF THE EDUCATIONAL UNIT IN WHICH THEY ARE MATRICULATED**

Throughout their training, MD-PhD students are subject to the policies of the educational unit in which they are matriculated, whether it be WCMC, GSK, RU or WCGS — keeping in mind that MD-PhD students in their research training must abide by the standards for professional conduct that apply to MD students at WCMC.

#### **MD-PHD STUDENTS ARE FULL-TIME STUDENTS**

Students in the Tri-Institutional MD-PhD Program are full-time students of science and medicine and are expected to engage full-time in advanced studies and research. This is a demanding educational program that is designed to train you as a clinician and a researcher, which should occupy most of your waking hours. The MD-PhD Program therefore does not permit students to engage in extramural activities for compensation under any circumstances.

Students in good academic standing may participate in extracurricular activities within the Tri-Institutional community, as long as these do not interfere in any way with the student's progress in course work, clerkships or thesis research, as determined by the thesis advisor (if applicable) and Program Director, who may consult with the Senior Associate Dean (Education) at WCMC or the relevant graduate school Dean. With prior permission from the thesis advisor (if applicable) and the Program Director, students in good academic standing also may participate in volunteer activities outside the Tri-Institutional community, as long as these do not interfere in any way with the student's progress in course work, clerkships or thesis research.

If it is deemed that an activity, whether a formal intramural or extramural activity or an informal activity done as a personal avocation (e.g., participation in the arts, sports or other hobbies), is interfering with a student's progress in the training program, the Program Director will "request" that the student reduces or altogether curtails such activities.

#### FINANCIAL SUPPORT — GENERAL PRINCIPLES

It is the policy of the Tri-Institutional MD-PhD Program that all students in the program should be fully funded, meaning that they receive a fellowship consisting of a stipend, full tuition scholarship and health and dental insurance (see below for the special circumstances that pertain to the clinical training). But please note that the fellowship is contingent on the student being in **good academic standing**—meaning that he/she satisfy the medical college and graduate school requirements in a timely manner and generally adhere to the standards of conduct and academic performance expected of future physician-scientists.

All MD-PhD students, including students in the graduate school years, receive their stipends and benefits through WCMC. The program office arranges for the distribution of stipends and the travel and book funds during the first two years of medical college training. The graduate research accounts (see below) are administered through the respective graduate school Offices.

The two main sources of support are: the Medical Scientist Training Program (MSTP) grant that we receive from the National Institute of General Medical Sciences at NIH; and funds provided by the three institutions. In addition, many students have independent predoctoral fellowships from the NIH and other funding sources, and a limited number of named fellowships are administered by the Program Office. Some students in their research years (CD5 and beyond) receive stipend support from their thesis advisor's research grant(s). Whatever the initial source(s) of support, after 4.5 years of research training all MD-PhD students receive their stipend support from their advisor's research budget.

We expect all MD-PhD students to apply for independent fellowship support in CD4 (after they have presented/defended their research proposal); but funding does not depend on their receiving such support. Some fellowships programs restrict the number of applications from any training entity. It is **important that students inform the program office what fellowship(s) they intend to apply for before they begin writing the proposal(s)**. Students, who are awarded an independent fellowship that provides more than 50% of their stipend, will receive a stipend supplement of \$5,000 each year they are supported by the fellowship.

#### FINANCIAL SUPPORT DURING THE CLINICAL TRAINING

Tri-Institutional MD-PhD students who matriculated in 2013 or earlier receive stipend support for a maximum of 23 months of clerkship training (including time for independent studies and research electives). Students who matriculated in 2014 receive stipend support for a maximum of 21 months of clerkship training following the defense of their PhD thesis (including time for independent studies and research electives); students who matriculated in 2015 and later receive stipend support for a maximum of 18 months of clerkship training following the defense of their PhD thesis (including time for independent studies and research electives). Students who have an independent fellowship may appeal for special consideration.

Students whose clinical training (including time for independent studies and research electives) exceeds the limits set above, and who are in good academic standing, will continue to receive health and dental insurance, will not be charged tuition, and will be eligible for housing.

Students who need more than their allocated time of stipend support, as specified above, may apply for independent fellowship support.

#### STUDENTS WITH OUTSTANDING FEES

Money owed to any of the institutions that comprise the Tri-Institutional MD-PhD Program must be paid in full before a graduate can receive her/his diploma, whether it be PhD or MD. Consequently, all individual charges, including tuition and rent must be paid in full. Any student who has received WCMC financial aid must make an appointment to have an exit interview with the Director of Financial Aid at WCMC. Students with WCMC loans will receive information about Exit Counseling from the WCMC Office of Financial Aid.

#### Housing

All MD-PhD students are guaranteed housing; family housing is available, but limited. Students have the option to live off-campus.

The three institutions share the responsibility for housing MD-PhD students, with each institution's share of the responsibility being determined by the number of students that pursue their training in that institution. For the AY 2015-16, MD-PhD students will be housed by WCMC during CD1 through CD4—together with the medical college class with which they enrolled. During CD5 and CD6, MD-PhD students (irrespective of which graduate school they are matriculated in) will be housed by WCGS (and live in WCMC or SKI housing). In CD7+ the students will be housed by RU. When MD-PhD students move to RU, they participate in the RU housing lottery.

#### Student Guide to the Tri-Institutional MD-PhD Program

MD-PhD students are subject to the housing policies of the institution that provides their housing. These policies evolve, and it is the students' responsibility to acquaint themselves with the relevant, current policies.

#### INSURANCE

All MD-PhD students, whether matriculated in WCMC, GSK, RU or WCGS, are covered by the WCMC *health, dental and disability insurance* plans. MD-PhD students can sign up for vision and extended dental coverage, but they would need to pay the premiums.

MD-PhD students who are matriculated in WCMC—in CD1 and CD2 and their final clinical training (including the Introductory Clerkship the summer before they defend their thesis)—are covered by the WCMC *malpractice/liability insurance* plan for MD students. MD-PhD students who participate in short-term clinical electives during their research training also are covered, whether they are matriculated at GSK, RU or WCGS, provided the students are under the direct supervision of a WCMC faculty member.

#### EXTENSION OF THE LENGTH OF TRAINING BEYOND EIGHT YEARS

If a student and her/his advisor find that the student cannot (or is unlikely to) complete the thesis research in time to graduate from the program in eight years ( $4\frac{1}{2}$  years of thesis research), they can petition the Program Director in writing for an extension of one year. The request should be received no later than April 31 of CD6 (at the end of the forth year of research training), and should include a timeline for how the thesis research will be brought to fruition; this document should be signed by the student as well as the thesis advisor. The Program Director will forward the request to the relevant graduate school Dean for consultation. If an extension is granted, the advisor will be financially responsible for the student's stipend and health benefits, but not the tuition, from July 1 through June 30 of CD7.

#### VACATIONS, PARENTAL LEAVE AND LEAVE-OF-ABSENCE

**Vacation** Students may take an annual vacation of up to two weeks, in addition to official institutional closings (Scheduled Breaks, Christmas and National Holidays) and major religious observances.

Students in their first two years of medical school education and their final clinical training cannot take vacation during any time students are supposed to participate in structured educational activities. For students in their research training, the timing of their vacations should be agreed upon between the student and the thesis advisor. Grievances can be brought to the Program Director.

**Sick Leave and Other Leave** Students may continue to receive stipends for up to 15 days of sick leave per year. Sick leave may be used for medical conditions related to pregnancy and childbirth.

**Parental Leave** Students may receive stipends for up to eight weeks of parental leave per year for the adoption or the birth of a child. Parental leave must be requested at least 30 days in advance of the anticipated beginning date, and must be approved by the Program Director and, when appropriate, the thesis advisor.

**Unpaid Leave** Students requiring extended periods of time away from their training—more than 15 days of sick leave and/or more than eight weeks of parental leave—must seek approval from the Program Director for an unpaid leave of absence. For students receiving external

fellowship support the leave shall be subject to approval from the funding source. Whenever possible, approval for a leave of absence must be requested in advance of the leave.

Students who request a leave-of-absence from WCMC will be charged a re-matriculation fee when they re-enroll into the program.

#### WITHDRAWAL FROM THE PROGRAM

Students who contemplate withdrawal from the MD-PhD Program should recognize that withdrawal has serious repercussions because they will lose all MD-PhD "privileges" including stipend, tuition and health and dental insurance support.

If they otherwise are in good academic standing, and with the permission of the Program Director and the appropriate dean, students who withdraw from the program can matriculate in the medical college or any of the graduate schools, where they will be subject to the policies and graduation requirements that apply to single-degree MD or PhD students. Students who wish to matriculate in the medical college, to complete their medical studies, will have to complete the full two years of clinical training in the medical college curriculum at their own expense.

If they are not in good academic standing, students who withdraw from the program would be able to continue their studies only if they apply to (and are accepted by) the medical college or graduate school they wish to matriculate in.

#### DISMISSAL FROM THE PROGRAM

Students who have been dismissed by the medical college or one of the graduate schools are automatically dismissed also by the MD-PhD Program and will lose MD-PhD stipend, tuition and health and dental insurance support. They would be able to continue their studies only if they apply to (and are accepted by) the Medical College or the graduate school they wish to matriculate in.

#### PROTECTION OF INTELLECTUAL PROPERTY RIGHTS

A student may not enter into any legal agreement involving her/his research without consulting her/his advisor **and** the relevant graduate school office – *as well as the MD-PhD Program Director*. Many organizations and investigators that supply research materials, which could be in the form of access to proprietary databases, insist that a Materials Transfer Agreement, or a similar document, be signed by the recipient. These are legal documents, and their wording may place (severe) restrictions on the use, and outcome of any use, of the supplied materials. If a student uses such supplied materials to make a patentable discovery, the student may discover that it is the supplier of the materials and not the student who owns the invention. Do not view such documents lightly, and do not sign any agreement that has the potential to limit your rights to any discovery without seeking advice. As a general rule, students should avoid signing any such documents and refer the matter to their advisor.

#### RESEARCH ACCOUNTS, BOOK AND TRAVEL FUNDS

The research activities of MD-PhD students are supported primarily by funds available to the laboratories in which they work. In addition, MD-PhD students receive a small research budget \$1,000 in CD1 and CD2, and \$1,500 in CD3 through CD7 (or 60 days after the student has defended her/his thesis, whichever comes first), which provides the students with some fiscal independence. Within a lab, the research funds enable the students to explore areas of interest that are not connected to aims of their advisor's grants by providing funds for supplies or

equipment. The research funds can also be used to attend scientific meetings and courses (e.g. at the Cold Spring Harbor Laboratory and the Marine Biological Laboratory). (The policies for taking courses outside the tri-institutional MD-PhD Program vary among the graduate schools; students should consult their graduate school.)

Except for CD1 and CD2, the unspent allocations are carried forward to the next fiscal year. Overdrafts will be deducted form the next fiscal year's budget, and each graduate school reserves the right to limit a student's spending based on the anticipated time to completing the graduate school training. If any overdraft remains when a student returns to her/his clinical training, they will be charged to the thesis advisor's account.

Students who are awarded individual fellowships may receive research budgets that are larger than \$1,500, if there are sufficient funds set aside for research-related expenses in the award.

The research funds for CD3 are not released until the student has matriculated in a graduate school.

The research accounts are managed by the student, but the student and advisor should agree on the expenditures that are needed for the student's research. Purchases exceeding \$500 require prior approval by the Office manager (at GSK), the Financial Administrator (at RU) or the Finance Coordinator (at WCGS) and must be briefly justified in writing (by the student) with approval by the advisor. To be reimbursed, students must submit original receipts for all expenses to the person who is responsible for the research funds at the relevant graduate school office.

Should a student change graduate school matriculation, any funds that are carried over from previous years will be forfeited. The current year's institutional contributions to the student's research account will be prorated by the number of months the student is matriculated in each graduate school. Any deficit in the research account cannot be transferred between graduate schools.

The use of the research funds is limited to supplies and expenses associated with the student's research. Stationery items, photocopying expenses, and specialized computer services that reasonably are needed for study, research and preparation of the thesis may be charged to the research budget. The funds also may be used to reimburse students for the purchase of scientific books and one periodical (if it is unavailable in the lab) — exceptions will be made for *Nature*, *New England Journal of Medicine*, and *Science* — up to a limit of \$200/year in the first two medical college years and \$500/year in the thesis research years. The research funds also may be used to pay for high-speed internet connections through the Rockefeller or Weill Cornell Academic Computing services. Reimbursements must be requested from, and approved by, the Financial Administrator (at RU) or the Registrar (at WCGS).

The research funds may *not* be used for a student's personal use (e.g. accommodation and hobbies), or to pay for other personal expenses (including photocopying and computer time). Any equipment item(s) purchased with student research funds (with the exception of personal computers) cannot be moved into the student's room. All equipment purchased with such funds must remain in the laboratory—and will stay there when the student graduates.

*Computer Purchases* MD-PhD students may **use their research funds** to purchase up to *two* computers during their tenure in the program, with no restrictions as to the kind of computer. The purchases must be a minimum of three years apart, and a student's total budget for computers is \$5,000. In addition to the two computers, students are allowed to buy also an iPad/tablet, as long as they stay within the \$5,000 limit. Computers and iPads/tablets must be purchased through the relevant Purchasing Department (students should contact the relevant

#### Student Guide to the Tri-Institutional MD-PhD Program

graduate school office for the specific policies). *Direct purchases from outside vendors will not be reimbursed*.

The computers are the students' personal property, and they will be responsible for service and maintenance (including backup). Also, students are reminded that most *software is subject to strict copyright and licensing restrictions*. These restrictions must be adhered to.

*Meetings and Courses* Students in CD1 and CD2 may use up to \$800/year (July 1 to June 30) and students in the research years may use up to \$1,500/year from the research budget to attend meetings and courses. For students in CD1 and CD2, participation in a meeting may conflict with their medical college course schedules. If that is the case, the student **must receive prior approval** from the relevant course director before registering for the meeting and planning the travel. The MD-PhD Program office must receive a copy of the letter giving permission; **travel expenses will not be reimbursed unless a copy of the permission letter is on file in the program office**. For students in their research years, the student's research advisor must send a letter, recommending attendance at the meeting/course, to the relevant graduate school office prior to the activity. (A student, who wishes to participate in a course directly related to their thesis research, can request an exemption from the \$1,500 limit. The request should be in writing, with approval from the thesis advisor.) Registration, travel and room charges must be documented with receipts; the food allowance is \$50/day (receipts not necessary).

MD-PhD students who participate actively (i.e. give an oral or poster presentation) at the National MD-PhD Students' Meeting in Keystone, CO, will get their registration and some travel expenses reimbursed by the MD-PhD Program. These funds do not count toward the \$800/\$1,500 limit.

Students in the final clinical training do not have a research budget. They can, however, request travel support from the MD-PhD Program to present their thesis research at a scientific conference. Such travel support will be awarded subject to available funds. Students who wish to apply for travel support should contact Ruth Gotian.

## PUBLICATIONS

It is the expectation that MD-PhD students will have at least **one first-author research article** published or in press in a peer-reviewed journal by the time they graduate from the program.

Students should provide the MD-PhD Program Office with the URL of any publication (except abstracts and their PhD thesis) on which they are an author or co-author. Please provide this information as soon as possible after publication. You also should list all publications (with their PubMed ID and PubMed Central ID, if available) that result from your research or other activities in the Program in your BioSketch.

#### ACKNOWLEDGMENT OF MD-PHD FELLOWSHIP SUPPORT IN PUBLICATIONS

ALL students who have been supported by the MSTP grant at some time during their studies must acknowledge the support in all publications (except abstracts) as follows (the wording is based on NIH policy, which can be found at <a href="http://grants.nih.gov/grants/acknow.htm">http://grants.nih.gov/grants/acknow.htm</a>): "X.Y.Z. was supported by a Medical Scientist Training Program grant from the National Institute of General Medical Sciences of the National Institutes of Health under award number (*in this format*): T32GM007739 to the Weill Cornell/Rockefeller/Sloan Kettering Tri-Institutional MD-PhD Program."

It does not matter whether the student is supported by the MSTP grant at the time the work is done or the manuscript is submitted. The important point is that the MSTP grant made it possible for the student to be here and do the work: "once an MSTP [student], always an MSTP!"

Students who are recipients of a F30 or F31 fellowship from NIH must include the following acknowledgment:

"X.Y.Z. was supported by a F30/31 Predoctoral Fellowship from **name of NIH Institute** of the National Institutes of Health under award number (*in this format*): F30GM007739 (insert the appropriate award identifier)."

According to NIH policy, the acknowledgment must include the following disclaimer: "The content of this study is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health."

**NIH's Public Access Policy** requires that ALL publications resulting from NIH funding (other than books, including PhD theses, and book chapters) be deposited in Pubmed Central within three months of publication. It is your, and your advisor's, responsibility to ensure that your articles are deposited in Pubmed Central!

Students who are/have been supported by any other fellowship, should acknowledge the support in this format: "X.Y.Z. was supported by **name of fellowship** from **source**".

# **APPENDIX A**

## **PROGRAM GOVERNANCE**

*Steering Committee* Overall responsibility for the Tri-Institutional MD-PhD Program resides with the steering committee, which is composed of the provost for medical affairs and dean of WCMC, the president of RU and the director of SKI. The Program Director participates on a non-voting basis, and a representative from the program leadership at each of the three institutions is invited to the meetings. The steering committee makes the major financial and policy decisions—usually on recommendation from the program's advisory committee (see below).

**MD-PhD Program Advisory Committee** This committee provides a forum for discussions of the concerns of both faculty and students, and the committee sets specific policies for the program within the guidelines set down by the steering committee. The members are: the Program Director; the associate directors; the dean at RU; the dean at GSK; the dean at WCGS; the senior associate dean (education) at WCMC; a faculty member from each of the three graduate divisions; the course director of *Introduction to Medicine for Clinical Investigators*; the chair of the *Career Counseling Committee* (see below); three MD-PhD students in their research years, one from each institution; and one MD-PhD student in medical college training. Additional, *ex officio* members represent the three participating institutions (the associate dean for educational affairs at RU; the associate dean at WCGS; the associate dean at GSK) and the medical college (the associate dean for admissions; and the associate dean for student affairs and equal opportunity programs).

*Executive Subcommittee* This committee assists the Program Director in the daily management of the program. The committee meets monthly to discuss current and upcoming issues that affect the program. The committee also prepares policy positions for deliberation of the program's advisory committee. The committee is chaired by the Program Director and consists of the program's associate directors and administrative director, the dean at GSK, the dean at RU, the dean at WCGS, the senior associate dean for education at WCMC—or their designees.

**Research Advisory Committee** This committee provides advice to the students during their first two years in the Program. The committee consists of the Program Director, who chairs the Committee, the Program's two associate directors (J. Buck, MD, PhD, and M. S. Pecker, MD), and a faculty member from each of the three institutions. The current members are: Hugh C. Hemmings, Jr., MD, PhD (WCMC); Ross L Levine, MD (SKI); and Sohail Tavazoie, MD, PhD (RU).

*Career Counseling Committee* This committee is charged with following the students' progress through their research years and final clinical training. The committee is chaired by Mark S. Pecker, MD. Its membership includes faculty members from clinical departments at WCMC, including the course director for *Introduction to Medicine for Clinical Investigators*, plus the members of the *Research Advisory Committee*.

## APPENDIX B

Memorandum that is sent to thesis advisors, which should be discussed by the advisor and student, signed by both after they have reviewed the material, and the signed copy should be sent to the MD-PhD Program office. The text varies, depending on the graduate school; this is the WCGS version.

Congratulations that StudentName has chosen your laboratory for her/his thesis research!

Enclosed please find the most recent version of the Student Guide to the Program. This guide was designed to help students conduct their studies in a timely manner, it may also be useful for you, as the training program for MD-PhD students differs slightly from that for PhD students (p. 8 in the guide "Graduate School Requirements"; you also may wish to examine the ACE requirements for MD-PhD students, pp. 36-38 in the Guide). These differences take into account that MD-PhD students begin their research training with different backgrounds than PhD students, and they reflect our efforts to maintain uniform requirements, with respect to courses, committee meetings and thesis defense, for all MD-PhD students—irrespective of the graduate school in which they are enrolled.

We also enclose the most recent versions of several documents—Graduate School Requirements for Tri-Institutional MD-PhD Students, Career Planning and Critical Dates and the AAMC Compact Between Biomedical Graduate Students and Their Research Advisors—that we distribute to all MD-PhD students at the beginning of their third year of combined degree training, CD3

Below is a summary of the main points to consider; please review this document with StudentSurname. Because some of these points relate to your financial responsibilities, we request that you both sign and return a copy of this memorandum to the MD-PhD Program office.

- 1. It is the aim of the Tri-Institutional MD-PhD Program to have the students complete their studies in 7 years: 3<sup>1</sup>/<sub>2</sub> years of medical school education; and 3<sup>1</sup>/<sub>2</sub> years of research training. We recognize this is an ambitious schedule, and that some students may need 4<sup>1</sup>/<sub>2</sub> years to complete their research training (for a total of 8 years in the Program). If one more year of training is needed, for a total of 9 years of training, it should be justified in writing to the MD-PhD Program office (see also #11, below).
- 2. All students receive full financial support (stipend, health & dental insurance and tuition coverage) for the duration of their training. The first two years of thesis research will be supported by institutional funds. The next one and a half (or two and a half) years will be supported either by institutional funds or by your research funds, as per institutional guidelines. The thesis advisor will assume the full financial responsibility for any student who needs more than four and a half years of research training.

In the event that you leave the tri-institutional campus, the MD-PhD Program office must be informed as soon as possible—preferably well in advance of the move. If StudentSurname decides to continue her/his research with you and remain in the Tri-I Program, you will be fully responsible for both stipend and health and dental insurance during the remaining thesis research.

3. In addition to stipend and health insurance, MD-PhD students receive an annual research supplement, currently \$1,500/year, during their research training (for up to 4<sup>1</sup>/<sub>2</sub> years),

which is paid from institutional funds. The guidelines for administering the research supplement can be found on pp. 28-30 in the student guide.

- 4. MD-PhD students must complete satisfactorily four course units. All graduate courses at the David Rockefeller graduate school, the Weill Cornell graduate school and the Gerstner Sloan Kettering graduate school are open to MD-PhD students, regardless of the graduate school in which they matriculate— assuming they satisfy the course prerequisites and there is room in the course. It is expected that MD-PhD students will take at least one course that is offered by the graduate program in which they enroll—and MD-PhD students are expected to be active participants in seminars and retreats (as per the graduate school policies for PhD students). They also are expected to be active participants at the MD-PhD Program's Annual Retreats.
- 5. In addition to their course requirements, MD-PhD students must submit a thesis research proposal (TRP) no later than August 31 of CD04 (their fourth year of combined degree training and second year of research training) and defend the proposal in front of their Committee by October 31 of CD04. (Writing and defending the TRP satisfies the requirements for passing the Admission to Candidacy, ACE, in the Weill Cornell Graduate School of Medical Sciences, WCGS.) Once these requirements have been satisfied, the students are free to focus fully on their thesis research. (The Program reserves the right to withhold the student's stipend if the research/thesis proposal has not been submitted by August 31 or defended by October 31 of CD04.)

The TRP should be written following the guidelines for an R01 research grant application, and time needed to write the TRP is similar to the time needed to write a conventional research proposal for the WCGS ACE.

After having presented/defended their TRP, MD-PhD students are expected to write an application for independent fellowship support based on their TRP; most students submit an F30 application for a predoctoral National Research Service Award, which should be submitted in early December of CD04. It therefore is important that the Committee provides constructive advice on how to turn the TRP into a competitive application for F30 support.

6. Students who apply for, and receive, independent fellowships that include stipend support for more than 50% of their MD-PhD stipend will receive a stipend supplement of \$5,000 each year they are supported by the fellowship. If the fellowship provides more than \$1,500 of research support, in addition to the stipend support, the research supplement will be increased to the amount awarded by the fellowship.

If the fellowship/grant does not provide stipend support, StudentSurname will not receive the stipend supplement.

- 7. Once StudentSurname has defended her/his TRP, he/she must annually present original data in a formal scientific venue. This requirement can be fulfilled by presenting a **talk** at the annual MD-PhD retreat, the Du Vigneaud Memorial Symposium hosted by the WCGS, or various Departmental/Institutional Seminar Series or a **poster or talk** at any national or international scientific meeting. Fulfillment of this requirement must be verified at StudentSurname's biannual committee meetings. Students are required to submit to the Committee and the MD-PhD Program office the abstract of the presentation.
- 8. As a reflection of the Tri-Institutional Program Structure, all MD-PhD students must have faculty from either the Rockefeller or the Gerstner Sloan Kettering (GSK) graduate

schools on their Committees (the GSK faculty member cannot be a member of the Weill Cornell graduate school). The Committee structure and responsibilities are otherwise the same as for PhD students in the Weill Cornell graduate school.

9. To ensure that students graduate in a timely manner, we require that they have biannual committee meetings to monitor their progress. The committee meetings usually are in November-October and May-June. We reserve the right to withhold stipend checks for students who have not had their two committee meetings by June 30 of each Academic Year.

The Program Director may be present at the committee meetings, especially the first meeting in CD05 (the third year of research training) where the Committee will decide whether StudentSurname's progress has been sufficient to allow him/her to graduate during the fall semester of the next academic year.

The MD-PhD Program office should receive copies of the committee reports from your graduate school office; but whenever progress is of concern, you should notify the program office well before the committee meeting. (In practice we cannot determine whether a committee meeting has taken place unless we receive the copy of the committee report. It is important that the committee reports be submitted as soon as possible after the committee meeting— StudentSurname's stipend may be withheld if the report has not been submitted to the graduate school office.)

- 10. If StudentSurname has not defended her/his thesis by the fall semester of CD06 (fourth year of research training), the MD-PhD Program office must be informed, and the Program Director should be invited to the second committee meeting, which should be in April-May, where StudentSurname's progress will be discussed to determine the likelihood that StudentSurname will be able to defend her/his thesis in time to return to the clinical training in early January of CD07. If clear progress is evident, StudentSurname's situation will be evaluated at regular intervals by the thesis advisor and Program Director to ensure satisfactory completion of the thesis. If progress is unlikely, and it remains unclear whether StudentSurname will be able to graduate in a timely manner, StudentSurname may be asked to resign from the program effective July 1 to complete the two years of clinical training required for MD-only students.
- 11. Given the restrictions imposed by the New York State graduation and licensure requirements, MD-PhD students need to complete their thesis research and satisfactorily present and defend their thesis in the fall semester of the academic year before they graduate from the program.

The required clinical curriculum for MD-PhD students consists of 56 weeks of clerkship training (with 48 weeks per Academic Year). Some students need additional time to explore clinical specialties, and it would be prudent to plan the thesis research (to the extent it can be planned) such that StudentSurname defends her/his thesis in August-September of their penultimate year of training.

Students who defend early may have completed their clinical training during the fall semester of their final year of training, and the Program encourages all MD-PhD students to return to the laboratory, whether their thesis laboratory or a laboratory chosen based on the students career planning, for the last part of their training.

12. The Program encourages students to explore clinical career options during their thesis research. These explorations, usually one morning or afternoon per week for a number of weeks, occur in late CD04 and beyond. These explorations are important because

students who know (more or less) what clinical (or post-doctoral) training they plan to pursue need less time for explorations during their clinical training — and can thus return (defend their thesis) later than if they not explored their post-graduate career options or, alternatively, spend more time in the laboratory after they have completed their clinical training.

13. It is the expectation that MD-PhD students will have at least one first-author publication published or in press in a peer-reviewed journal by the time they graduate from the Program—when they have received both their PhD and their MD.

All publications on which StudentSurname is a coauthor should acknowledge the Medical Scientist Training (MSTP) grant (P. 31 in the Student Guide). The Program is required to list all publications that were authored/co-authored by students who were supported by the MSTP grant in the annual Research Progress Performance Report (RPPR), and the publication list will be checked for compliance with the NIH's Open-Access requirement. The thesis advisors are responsible for ensuring that all peer-reviewed articles on which a MD-PhD student is an author/coauthor are submitted to PubMed Central and that they become PMC-compliant. The students are responsible for providing the PMCID number for each peer-reviewed article to the MD-PhD Program Office when they update their publication list.

14. In case of medical emergencies, or other serious and unexpected events, the MD-PhD Program office should be notified immediately.

# APPENDIX C

#### THE QUALIFYING EXAMINATION FOR MD-PHD STUDENTS

Before MD-PhD students can concentrate fully on their thesis the students must present and defend a Thesis Proposal (TP) at GSK, a Thesis Research Proposal (TRP) at RU or pass the Admission to Candidacy Examination (ACE) at WCGS. This qualifying examination consists of a written research proposal, and an oral presentation/examination based on the proposal. Because MD-PhD students enter their graduate training after two years of medical school education, they usually write and defend a TP/TRP — irrespective of which graduate school they are enrolled in.

In order to present and defend the TP/TRP, MD-PhD students must have passed all required graduate courses (exceptions are made for courses given every other year). If a student has not completed her/his course requirements, he/she should meet with the Program Director to discuss the situation.

Students usually begin writing the TP/TRP toward the end of their first research year (CD 3). As the proposal is being written, the student should select an Advisory Committee (AC), at GSK, a Faculty Advisory Committee (FAC), at RU, or Special Committee (SC), at WCGS. The committee members are chosen for their expertise in areas relating the thesis research. MD-PhD students in RU or WCGS should have a faculty member from another graduate school (WCGS or GSK in the case of RU students; RU or GSK in the case of WCGS students, the GSK faculty member cannot be a member of WCGS) on their committee. The usual committee composition is three members from the graduate school in which they are matriculated plus one additional member (for students matriculated in RU or WCGS).

The TRP should be submitted to the MD-PhD Program office, the relevant graduate school office and the student's committee no later than August 31 of CD4, and the TRP should be presented and defended no later than October 31 of CD4. This timeline will enable students to submit their F30 application (see CONVERTING THE THESIS RESEARCH PROPOSAL TO AN INDEPENDENT FELLOWSHIP APPLICATION) in December of CD4.

AT GSK, the proposal is presented to a Thesis Proposal Examining Committee (TPEC), which is composed by the student's AC minus the thesis advisor, plus two additional faculty members. At RU the proposal is presented at the first annual meeting of the FAC, which is both the student's advisory and examining committee.

At WCGS, the proposal is presented to an examining committee (EC) composed of the SC plus a chairperson, who must be a WCGS faculty member.

#### It is the student's responsibility to:

1. Contact all members of the TPEC, FAC or EC to ask whether he/she is willing to serve on the committee, and (for students in WCGS) inform the committee members about the scope of the proposal—that it is a thesis research proposal. The final composition of the committees is subject to the approval of the relevant graduate school — and the graduate school may appoint one or more members.

(As noted above, MD-PhD students in RU or WCGS should have a faculty member from another graduate school (WCGS or GSK in the case of RU students, RU or GSK in the case of WCGS students) on their committee.)

2. Schedule the meeting of the TPAC, FAC or EC and the oral presentation/defense of the proposal.

3. Make sure all GSK, RU or WCGS general requirements for scheduling and presenting TP/TRP are met, and that all relevant information and documents/forms are submitted the graduate school office in a timely manner (students need to read up on the relevant graduate school's policies, which are revised regularly).

Timely scheduling is important; exams have been cancelled (and re-scheduled) because a student did not provide the necessary information in a timely manner.

#### STRUCTURE OF THE THESIS RESEARCH PROPOSAL

The proposal should be written in the format of an NIH R01 grant application—adhering to the page limitations, margins and fonts that are specified in the instructions—but without the administrative information that NIH requires (more information below). Students should consult <u>http://grants.nih.gov/grants/funding/phs398/phs398.html</u> for instructions about how to prepare the document; they also should consult the guidelines to reviewers of R01 applications <u>http://grants.nih.gov/grants/peer/critiques/rpg.htm</u>, as they provide many useful hints.

The proposal consists of the following parts:

- A. Project Summary and Relevance (see Instructions for PHS 398, section 4.2.1)
- B. Research Plan (see Instructions for PHS 398, section 5), including
- 1. Specific Aims (1 single-spaced page) Succinct statement of the problem to be addressed, the expected outcome(s) and the likely impact of the proposed research.
- 2. Research Strategy (12 single-spaced pages, including figures and tables):
- a. Significance Why is this an important problem? How will it improve scientific knowledge? This should be discussed within the context of the existing, pertinent literature.
- b. Innovation How will the proposed research change the way people think about the problem to be investigated? What is new — in terms of methodologies, instrumentation, and concepts?
- c. Approach (including preliminary studies. Experimental design and strategy, methodology and analysis. Potential problems and alternative strategies. How to assess whether this is likely to work out as planned? Alternative approaches for experiments that may not be feasible. Are there laboratory safety issues? If so, how will they be managed?
- Bibliography Should be comprehensive, with full titles.
- 4. Protection of Human Subjects (if applicable)
- 5. Vertebrate Animals (if applicable)

The proposal must be written by the student. The thesis advisor may provide guidance, but may not write any part of the proposal or provide the student with a previously written grant proposal on the same subject. It is acceptable, however, for the student to look at the advisor's NIH research proposals (on different topics), to get an idea of what is expected.

The proposal is distributed to the members of the student's committee; the rules vary among the graduate schools. Students are encouraged to contact the Committee members one-to-two weeks after distributing the proposal, to find out if the Committee member has identified any problems or weaknesses. The proposal may/should be revised after these discussions.

#### Student Guide to the Tri-Institutional MD-PhD Program

At the oral presentation the student will present the proposal. The student should prepare a 30 to 45 min formal presentation (and expect to be in the room for 90 to 120 min). The EC or FAC members will ask questions during and/or after the presentation. Remember, anything that is written in the proposal or said during the presentation may be questioned in detail. The evaluation will be according to the guidelines in the graduate school in which the student is matriculated.

MD-PhD students are in training to become a physician-scientist (broadly defined), and it would be appropriate if the proposal (in Significance and Innovation) discusses the problem in question at different levels of organization — at the: molecular level; cellular or organ level; and organismal level (preferably disease-related).

# CONVERTING THE THESIS RESEARCH PROPOSAL TO AN INDEPENDENT FELLOWSHIP APPLICATION

All students should convert their TRP into an application for external fellowship support (e.g., a F30 pre-doctoral National Research Service Award [NRSA] to one of the NIH categorical institutes) — and, to ensure that the committee members provide constructive suggestions for how to turn the TRP into an F30 application, the student should inform the examining committee that he/she plans to do so.

The application should be structured according to the guidelines for the funding agency; it is the student's responsibility to contact the appropriate program officer to ascertain whether the proposal is likely to fall within the funding agency's mission.

When preparing the application, it is important to note that the page limitations for the Research Plan in a fellowship application usually will differ from those for the TRP. In the case of F30/31 applications, for example, the Research Plan is limited to six pages. The student should consult <u>http://grants.nih.gov/grants/guide/pa-files/PA-14-150.html</u> for instructions on how to prepare the application and the guidelines to reviewers of pre-doctoral fellowship applications: <u>https://grants.nih.gov/grants/peer/f\_awards/f30\_guide\_for\_reviewers.pdf</u>. Students also should consult the resources available on the Program's wiki.

Another resource is a list of successful F31 applications that have been posted on the NIGMS website: <u>http://www.nigms.nih.gov/Training/IndivPredoc/Pages/Predoctoral-F31-Sample-Applications.aspx</u>

Finally, to get the maximum feedback from the committee members, the student should tell the committee members that he/she plans to convert the TRP into an application for predoctoral fellowship support — and end her/his presentation with a slide that summarizes the Specific Aims — to structure the discussion about the fellowship proposal, which becomes important during the preparation of the proposal.

## APPENDIX D

### FORMAT FOR FRONTIERS IN BIOMEDICAL SCIENCE COURSES

(Letter sent to faculty teaching Frontiers I, a similar letter is sent to faculty teaching Frontiers II)

- To: Faculty teaching Frontiers in Biomedical Science I: Critical Reading of Scientific Literature
- From: Olaf S. Andersen Director, Tri-Institutional MD-PhD Program Jochen Buck Associate Director, Tri-Institutional MD-PhD Program

Thank you very much for agreeing to participate in the Frontiers in Biomedical Science course for First Year MD-PhD students. The course is directed by Dr. J. Buck and has been organized by Drs. S. Blanchard, C. Blobel, J. Buck and J. Kaltschmidt. The goals of Frontiers are two-fold: to teach MD-PhD students to critically read the scientific literature – and thereby provide an introduction to critical thinking in an experimental context; and to convey the "joy of science" which is difficult to convey in the medical school curriculum. To achieve these goals, please structure your session in a manner that maximizes student participation.

While these goals can be achieved in many different ways, experience has shown that the following format works well:

- 1. Briefly introduce yourself, your previous research career, and your current research interests.
- 2. Provide a 30 min general introduction to the problem putting the articles to be discussed in context. The students really appreciate if you delineate the historical development of the topic to be discussed. In fact, the hallmark of successful sessions seems to be that the faculty member focuses on a "great story." This not only helps them get insight into the underlying issues, it also helps them retain the information better.
- 3. Segue into a 45 60 min intense discussion of the article(s) you assigned.
  - a. You should not use your own articles. The students' willingness to be actively involved and critical of the material diminishes when the articles are from your laboratory.
  - b. You should list some key questions on a sheet provided with the articles. The discussion should emphasize the following questions. Why is the problem important? Why were these particular experiments done? How were they done (experimental design)? Was the experimental approach useful in light of the underlying problem? Were the conclusions justified?
  - c. If you choose to give out more than one research article, you should provide the students with a brief rationale for why you do so. However, please remember, the students are MD-PhD students, with a significant medical school course load. You should assign no more than two articles. The total length of the articles that you hand out should be no more than 20 pages.
  - d. It can be useful if you can find articles that reach mutually contradictory conclusions or that examines an important problem using complementary methods.

- e. Another possibility is to take two brief review articles, one being a classical, defining review and a second more recent review, along with an intervening experimental article that led to a paradigm shift.
- 4. Toward the end of the session you should focus on the Discussion section of the article(s). A common student complaint is that there is not sufficient emphasis on the "big picture," which often comes up during the analysis of the Discussion. Finally, you should outline where you see the field moving conceptually and methodologically.

Different topics may require different approaches. The main point is that you structure your presentation to maximize student participation.

While students do not like to discuss articles written by faculty presenters, they want information about ongoing research in the Tri-Institutional Program; therefore, please bring selected reprints to distribute to the students, as this is your chance to meet and make an impression on the students.

We have established a forum, the Pre-Sessions, where the students will discuss the articles before the session with you. It is therefore important that you make the articles available in the MD-PhD Program Office **no later than two weeks before your session on**\_\_\_\_\_\_. If you assign more than one article, please indicate clearly the article(s) being assigned for background information and the article(s) that will be gone over in detail.

The student performances will be evaluated (pass/fail) based on attendance and participation. Students who do not participate actively will be given a take-home exam at the end of the course.

The students will evaluate the faculty using the enclosed questionnaire (Appendix E2 in this Guide).

# **APPENDIX E1**

#### WEILL CORNELL/ROCKEFELLER/SLOAN KETTERING TRI-INSTITUTIONAL MD-PHD PROGRAM LABORATORY ROTATION EVALUATION

An MD-PhD student worked in your laboratory as a rotation student in partial fulfillment of the requirements of the MD-PhD Program. We need your evaluation of this student's performance.

# Please review this evaluation with the student, <u>prior</u> to submitting it to the MD-PhD Program office.

The evaluations are filed in the MD-PhD office and a copy is forwarded to the graduate school upon matriculation.

Student's Name \_\_\_\_\_ Year in Program \_\_\_\_\_

Faculty Rotation Advisor \_\_\_\_\_ Summer (add year) \_\_\_\_\_

	Satisfactory	Unsatisfactory
Laboratory skills		
Knowledge of rationale for experiments		
Ability to apply knowledge		
Ability to reason		
Ability to function independently		
Responsibility/Maturity		
Motivation		
Creativity		
Relationships with laboratory personnel		
Potential for career in biomedical research		
Overall evaluation		

## BRIEF DESCRIPTION OF ROTATION PROJECT

## DETAILED COMMENTS REGARDING STUDENT'S PERFORMANCE

Signed \_\_\_\_\_

Date

Please return to the MD-PhD Program office <a href="mdphd@med.cornell.edu">mdphd@med.cornell.edu</a> or fax: 746-8678.

# **APPENDIX E2**

FACULTY EVALUATION QUESTIONNAIRE FOR FRONTIERS IN BIOMEDICAL SCIENCE

# FRONTIERS IN BIOMEDICAL SCIENCE Faculty evaluation form

Date of Session:

Name of Faculty:

In the entries below please answer yes/no or quantify on a scale of 1-5, 5 being highest. Please circle your response.

If the faculty presented uses a format that differs from the "standard" format, please use the narrative section for your evaluation.

#### Reading Material

Was the reading material available the week before the session?	Y	Ν
Did the faculty member use article(s) from her/his own laboratory?	Y	Ν
Were the article(s) well chosen, useful, and interesting?	Y	Ν

#### **Presentation**

Was the background presentation of appropriate length?	12345
Did the presentation give a good overview of the field in general?	12345
Did the presentation help you appreciate better the material in the article?	12345

#### Discussion

Was there sufficient time for discussion of the article?	12345
Did the background presentation, or article discussion, help you understand the	12345
pitfalls involved in doing the experiments and interpreting the results?	

#### General

Was there a summarizing discussion?	Y N	
Did the session increase your interest in the topic?	1234	15
Did the session increase your ability to read scientific research papers critically?	1234	15

Below please make any other comments you may have about the session:

## **APPENDIX E3**

#### WEILL CORNELL/ROCKEFELLER/SLOAN KETTERING TRI-INSTITUTIONAL MD-PHD PROGRAM ROTATION LABORATORY EVALUATION

Please complete this survey regarding your recently completed summer lab rotation. The surveys will be filed in the MD-PhD Program office. The information you give will <u>NOT</u> be shared with the Principal Investigator for whom you worked. With your permission it will be shared with other MD-PhD students interested in rotating in the lab; however, if you wish your name will be withheld. Thank you for taking the time to complete the survey.

Name	Year in Program	
Faculty Rotation Advisor	Summer of	

#### General Information:

- How many people worked in the lab at the time of your rotation?
- Estimated ratio of post-docs to PhD students:
- Did you have your own desk for the summer?
- Were the aims for the rotation clearly defined?
- How was your project selected?
- Was the PI available to discuss your project? How often?
- Was the PI supportive of your aims?
- Did you work on your own project, or did you work with someone else – if so, with whom (grad student, post-doc)?
- What did you learn (techniques, science, other things)?
- Looking back, was your project focused/reasonable?
- How was the general laboratory environment?
- Did the lab have a journal club?
- What was the nature of lab meetings (how often, scope of meeting)?

# Brief description of rotation project

Additional Comments about the rotation (positive or negative)

Please return to the MD-PhD Program <a href="mailto:mdphd@med.cornell.edu">mdphd@med.cornell.edu</a> or fax: 746-8678

# APPENDIX F

#### How to WRITE A SCIENTIFIC PAPER

These notes summarize some points OSA considers to be important when writing a scientific paper or report; they are not meant to be a comprehensive guide for how to prepare scientific manuscripts. The emphasis is on manuscripts relating to experimental studies; the extension to theoretical studies and interim reports should be straightforward.

When you write a scientific paper, you write for an audience; you should aim to fulfill four goals. First, you should explain why the question you have chosen to work on is important – to guide your reader's thinking. Second, you should explain how you did the experiments – to help your reader evaluate whether the methods you used are appropriate for the problem at hand. Third, you should describe the results you obtained and describe the control experiments you did to substantiate your conclusions—and you should do so in a manner that allows the reader to evaluate whether your approach is a good one (or not). Fourth, you should discuss how these results change the way in which we should think about the question at hand – to educate your reader(s).

A good paper provides new insights into a problem. You are not just reporting facts, you are teaching! Therefore, think back to when you were introduced to the question, what difficulties did *you* have in terms of understanding the material? With the benefit of hindsight, how do you think your advisor should have described the problem and its significance? Write the paper to accomplish that goal!

It is important to recognize who your target audience is, and to write the paper in a style that will help you communicate your ideas and findings clearly and effectively. It usually is NOT helpful to describe the meandering path you took when trying to dig into the problems you met on your way. Rather, you should organize the paper such that the different elements, when combined, constitute a "good" story. Remember that you want to convince your reader that your work is really neat stuff—you are teaching!

It is important to write well; your readers will appreciate your efforts. Define all symbols and abbreviations; **avoid lab jargon**. ALWAYS spell-check any draft that you give to someone for critical reading and feedback. **It is insulting to your readers not to do so**. You are imposing on your readers' time; you should regard it as a precious resource. You also should make full use of grammar checkers, if they are available to you. (But, remember that "here" and "hear" will pass unscathed through a spell-checker and that grammar checkers tend to be not reliable— meaning that they detect only the most egregious errors; there is no substitute for careful reading of your drafts!)

Usually you write a scientific paper to report your successes. Sometimes, however, you may have worked hard in the laboratory, but with little to show for your efforts. That is OK—as long as you do not make a habit of it. In case you are in the situation that you have little to tell, it is often helpful to write a "progress report" in order to identify the problems that kept you back. You look at the problems differently when you put things down on paper. Such "progress reports" also can be used to fulfill various formal requirements, such a report at the end of a research rotation. But never even think of publishing such "progress reports."

#### Student Guide to the Tri-Institutional MD-PhD Program

From a practical point of view a paper consists of the following 11 parts:

- 1. Title Page. What question did you study? What did you find? Brief declarative statement(s). In addition: who you are and where you did the work?
- 2. Abstract. A brief summary of the question(s) you studied, the result(s) you obtained and the conclusion(s) you made. Be concise, less than 200 words.
- 3. Introduction. Why is this an important question; what has been done before; how will your experimental approach improve on previous work; what new information/insights did you obtain? This section should be written with full benefit of all that you have learned.
- 4. Materials and Methods. What materials did you use; what methods did you use; what controls did you do, including any statistical tests for significance.
- 5. Results. A description of those experimental results that you consider to be important for obtaining further insights into the question you set out to study. There is no need to follow the order in which you did the experiments. The presentation should be organized around the figures you plan to show, and the reader should be able to discern the thread from one set of experiments to the next.
- 6. Discussion. Start out by briefly summarizing your main results. Then you discuss the implications of your findings: what can you conclude; what remains uncertain; are there weaknesses in the experimental design, or the methods you used that force you to qualify your conclusions. With the benefit of hindsight, what would you have done differently?
- 7. Acknowledgments. Who supported the work? Who helped you: who provided advice; who commented on your early drafts of the paper; who cheered you up?
- 8. Bibliography. The papers (books, book chapters and other resources) **that you have read** and found useful in your work and that you cite in the paper. Remember, you may be asked to explain the content of any source you list in the bibliography.
- 9. Tables and table legends. Take care to organize any tables to maximize their readability. Once you have put the information into the table you prepare the table legend, which should be a brief definition of symbols, etc.
- 10. Figure legends. These are always positioned before the figures, but written after the figures have been prepared. Figure legends should not duplicate the main text, but explain the main elements in the figure to your reader.
- 11. Figures. Do not clutter. Each figure should have a simple message. In photomicrographs and gels, be sure to highlight the important elements/bands and explain in the legend what it is you have highlighted. Look at the papers you have read, decide which figures you find to be well prepared and which you dislike, and use the "good" figures as templates when preparing your own figures.

#### Student Guide to the Tri-Institutional MD-PhD Program

These 11 elements are not independent. In a good, well-written paper the different elements "fuse" into a whole. That is, you do not write the paper simply by writing a number of distinct parts. Whenever you change one part of the paper, you should make sure that your changes do not impact on other parts of the paper.

Different journals have different styles. Be sure to look at the latest "Instructions to Authors" and "Editorial Policies" for the journal you intend to submit your manuscript to. It would be a pity if your manuscript were sent back because it failed some bureaucratic criterion for suitability. Among such criteria, the most common are limits on the number of printed pages or figures, and the style of the figures. You also should note the style used for the bibliography.

You should look at other papers for examples of how to proceed. That will help you organize your own writing.

The order in which you write the various parts of paper is important. It usually is helpful to begin with the Material and Methods section. Then you should prepare drafts of the Figures and Tables and their Legends. Once you have the drafts prepared, you organize them in the order you think they should be presented. Then you can write the Results section—and you usually will find that you need to revise Materials and Methods because you forgot something important. Similarly, you often will find that you need to change the way in which the figures are drawn and organized. Do so while the idea for the change is fresh in your mind. The next step is to write the Discussion. Again, you may need to go back and revise the Results section: the order in which you present the results may need to be changed; you may find that a figure or table is missing, or that you need to emphasize things differently in the text or the legends.

A common error is to wait inserting your references, the papers you have read and wish to cite, until late in the writing. That is a serious mistake, as you will find that you focus your thoughts when you make decisions about what papers to cite – and where.

Once you have written Materials and Methods, Results (plus Figures, Tables and their Legends), and Discussion then you sit down and read the whole thing critically. Does it make sense, have you quoted the right articles; are you pleased with the product? Once you have made the necessary revisions, and have a draft that meets your standards, you write the Introduction. This is difficult, as you need to be as clear and concise as possible—in light of what you know now, as opposed to what you knew when you began the study. You will be practicing "revisionist history writing." Again, be sure to quote the pertinent articles that you found helpful when you planned your experiments. Finally, when you are satisfied with the product, you will prepare the Abstract, Title Page, and Bibliography.

Finally, a comment on plagiarism. Plagiarism is a serious violation of academic standards and scientific integrity. It can be defined as the "use or close imitation of the language and thoughts of another author and the representation of them as one's own original work" (http://en.wikipedia.org/wiki/Plagiarism).

It clearly is wrong to copy and paste without putting the text in question in quotes and citing the original source; it is equally wrong to copy and paste, and then do minor word-smithing, without acknowledging and citing the source. Though you may find that you cannot express a particular issue as well as one of your sources has done, you ALWAYS should strive to rephrase the issue in your own words—and acknowledge the source—even if you consider the issue at hand to be "common knowledge" (see above example). Plagiarism aside, this becomes particularly important in scientific writing because you do not really understand the problem at hand before you are able to express it in your own words.

So, always use your own words and cite any source that you used and found to be helpful during the writing of your manuscript.

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# APPENDIX G

#### How to Review a Manuscript:

A manuscript review should provide an effective feedback to editors and authors—so that editors can make informed decisions and authors can use the comments to improve the manuscript.

An effective review usually will include (many or all of) the following elements:

- 1. A summary of the reviewer's overall impression of the manuscript: does it address an important problem; are the conclusion(s) supported by the data; should the manuscript be accepted, rejected or returned with an invitation to submit a revised version.
- 2. A request (or requests) to include the results of additional experiments. This could be a request to increase the number of experimental observations that are used to buttress a specific point (to increase the statistical significance of the results). It also could be a request to do different/new experiments that would be critical for the authors' conclusion(s) (as controls or to examine specific alternative interpretations of the results).
- 3. A request (or requests) for additional analysis of existing results. The authors should be asked to extract as much information as possible out of their experimental results.
- 4. A request (or requests) to change the organization of the manuscript—to increase the manuscripts accessibility to the non-expert.
- 5. A request (or requests) to correct typographical and grammatical errors.

It is not the reviewer's responsibility to rewrite a manuscript. A manuscript maybe so disorganized, or incomplete, that it becomes impossible to evaluate it. If so, that should be noted in a pithy paragraph, or two. If the reviewer has a pleasant disposition, he/she may also write some general suggestions for how to improve the manuscript.

ELEMENTS OF THE REVIEW (in order of appearance):

- 1. A general summary of the reviewer's impression of the manuscript. Does the manuscript address an important or, at least, interesting problem or is it largely confirmatory? How much new information is provided? Are the conclusions justified—based on the general state of the field and the new results reported in the manuscript? Is the presentation (the quality of the writing, and the length of the manuscript) appropriate for the amount of new information that is provided?
- 2. An in-depth listing of the reviewer's major concerns: are the methods appropriate; are the experiments done with sufficient care; were the right experiments—and the right control experiments—done; are the Figures and Table in the manuscript prepared well, and necessary (and sufficient) to make the point(s) the author(s) wish to make; is the analysis sufficient; are the interpretations correct (or at least reasonable)—could (some of) the results be interpreted differently?
- 3. A "line-by-line" review, starting with the Abstract and ending with the Figures, in which the reviewer identifies areas where the presentation could be improved. These comments could be: identification of typographical/grammatical errors; suggestions for bolstering a specific argument; suggestions for shortening the text; and suggestions for reorganizing the figures.

Finally: a common problem with reviews is that they are too "fuzzy." It is difficult to review a manuscript, and one needs to have expertise and courage to make terse statements—even to one's friends.