MD-PhD Timeline – Overview for the “New” Curriculum
Please read the detailed material that follows carefully

The new curriculum affects the timeline for MD-PhD students matriculating in Fall of 2015 and thereafter. The timeline outlined below may be revised as PhD-granting departments continue to evaluate the impact of the new curriculum on MD-PhD coursework and timeline to the PhD.

Year 1:
- Discuss course selections with Dr. Kazmierczak, Dr. Gorelick and your Faculty Mentor
- Current MD-PhD students can also offer insight into courses
- You must earn 2 Honors to satisfy the Graduate School’s Honors requirement. This can be accomplished by obtaining credit for some courses taken during Medical School
- Start thinking about your future research interests
- Every student completes two 4-5 week laboratory rotations during the summer after the first year.

Year 2:
- Discuss course selections with Dr. Kazmierczak, Dr. Gorelick and your Faculty Mentor
- All students must engage in 6 months of clinical clerkships
- Identify a thesis lab by the spring semester of Year 2 and complete affiliation paperwork
- Meet with the Director of Graduate Studies when you have made a decision about the lab where you want to affiliate to make sure your thesis advisor and department are compatible.

Year 3:
- We encourage students to take Step I of the Boards in July/August after completion of year 2. Step I must be completed by December 31st of this year.
- Begin Graduate School courses
- Meet with the Director of Graduate Studies (DGS) of the Ph.D. department to discuss the timing and protocol for the qualifying exam
- Begin planning F30/F31 submissions

Year 4:
- Continue with courses in the Graduate School and complete 2 Honors requirement. Continue thesis research
- Complete the Qualifying Examination and thesis prospectus by the fall semester of Year 4
- Submit F30/F31 by April
- Eligible to Teaching for Requirement after Passing Qualifying Exam

Year 5 to Completion of Thesis:
- Continue thesis research
- Thesis must be approved and defended prior to re-entry to medical school
- Submission of a first-author peer reviewed science manuscript is expected
- Meet with Associate Director for Clinical Affairs to complete Re-Entry requirements

Any digression from this timeline must be discussed and approved by the DGS and the MD-PhD Program and documented in the student’s file. Continued participation in the MD-PhD Program requires timely completion of requirements.
**Detailed MD-PhD Timeline**

**Early Matriculation.** Incoming students have the option of matriculating early (before beginning first-year medical school classes) to do their first lab rotation at Yale, through either the START@Yale Program or independently in an approved PhD lab. Funding is provided. Students must their choice of research mentor with Dr. Kazmierczak or Dr. Peter Aronson if participating in START@Yale.

**Year One:** MD-PhD students complete courses in the Medical School. One of the first decisions entering MD-PhD students will have to make in the first two weeks of the Program is what graduate courses to take for credit. Registration for MD/PhD students (courses, clinical clerkships, dissertation research, etc.) is processed online and through the MD/PhD Program Office. Sue will assist you in the registration process at the beginning of each semester.

The Graduate School requires that you obtain two **Honors** before the end of your 2nd year as a PhD student to continue registration. That is their **only** requirement, but it is **strictly enforced**. A number of first and second year courses, required and elective, can be taken for the Honors requirement, as can PhD courses in Years 3 & 4.

**You will be responsible for selecting your course work;** there are no specific course requirements for MD-PhD students. You should take courses that interest and excite you and that are relevant to your future graduate program.

Some of the required Medical School courses are co-listed as Graduate School courses and are required courses for some of the graduate programs. The more of these courses that you take for credit in the Graduate School during your first and second years, the fewer course requirements you will have to satisfy later in the Graduate School years. In general, it is a good idea to take as many of the first- and second-year Medical School courses for credit in the Graduate School as possible. To receive credit for these courses in the Graduate School, you must list them on your Graduate School Course Enrollment Form, so they appear on your Graduate School transcript.

- **Now is the time to begin thinking about your future research interests, which graduate program would be most appropriate, and their course requirements.**

For example, the INP and Neurobiology Programs require you to take Principles of Neuroscience (Neuroscience 501a) and Structural and Functional Analysis of the Human Nervous System (Neurobiology 500b). You will take the Neurobiology 500b automatically as part of the first-year Medical School curriculum. The INP strongly recommends that students who have a strong interest in the neurosciences also take the “Principles” course in their first year because of educational and scheduling issues that arise if taken later. Please speak with Charles Greer, Director of the INP and Carol Russo, Administrator of the INP, for details.

Another example is Cell Bio 502 a/b/c, listed in the Graduate School catalogue. It is one of the required courses for the Cell Biology Program and an elective for the INP and MB&B Programs. To receive credit for this course you must provide your grades to Dr. Peter Takizawa on the questions that been graded as part your qualifier.

Finally, MB&B 800 can be taken in place of the Biochem course conferences. That will entail reading original papers, etc. MB&B 800 is an elective for the INP and MB&B Graduate Programs. Please discuss details of this course with Dr. Susan Baserga, the course director.

- **Cell Biology 601 and MB&B 800 are courses that were primarily designed for MD-PhD students.** Again, we strongly suggest that you sign up for these courses if your interests are in biochemistry, cell biology, genetics, developmental biology, or related disciplines. Cell Biology 601 is a
requirement for the Cell Biology Graduate Program and electives for the INP and MB&B Graduate Programs. To reflect the specific educational goals of MD-PhD students, the content of this course has been designed to provide a foundation for your careers as physician-scientists. In this course you will receive valuable experience in researching, critically evaluating and presenting scientific information while working one-on-one with a faculty mentor. This course has been a favorite of both students and mentors and has shaped laboratory rotations for many students.

This summary illustrates which courses can be taken during your first year. Look carefully at the course requirements for individual programs in the pages that follow -- and check with the DGS of the relevant program(s) for further details and updates. Requirements do change and there can be flexibility depending on your background. However, the final say concerning requirements is left up to the DGS and graduate program faculty. Don’t forget, there will be time to take Graduate School courses when you affiliate with a graduate program in your third year. Be aware that Medical School courses listed as required graduate program courses may not substitute for upper-level graduate courses in the individual programs. Each program has its own upper-level courses you that are required to ensure that your PhD training is on a par with that of regular PhD students.

Your graduate course work should provide exciting opportunities for new learning and supplement and reinforce your core medical school course. However, we offer a word of caution - there are many exciting educational opportunities at Yale, but you must also avoid being overloaded by taking an excessive number of courses. Such pursuits may compromise your ability to focus on what you must learn to advance through your first two years.

- Please schedule time to individually talk to us about graduate courses in the Program offices where we will have more details and contact numbers. Also, discuss this issue with senior MD-PhD students who have recently and successfully navigated these waters.

Details of Courses Co-listed as Medical School and Graduate School Courses (These can be taken for credit in years 1 & 2 without scheduling conflicts)  
**These courses are being offered for credit as far as we know**

**Course selections for students in lab and/or on the wards**
MEDC 999 01 (CRN) Courses in School of Medicine Staff 2 HTBA (2nd years)  
QUAL 999 01 (CRN) Preparing for Qualifying Exams Staff 2 HTBA  
CAND 999 01 (CRN) Prep: Admission to Candidacy Staff 2 HTBA  
DISR 999 01 (CRN) Diss Research - in Residence Staff 2 HTBA  
MEDR 999 01 (CRN) Clinical Clerkships Staff 2 HTBA

**Suggested courses for incoming 1st years (please do not register until after you meet with Drs. Kazmierczak and Gorelick on August 9th):**  
MEDC 999 01 (CRN) Courses in School of Medicine Staff 2 HTBA (1st and 2nd years)  
CBIO 502 01 (10530) Molecules to Systems Peter Takizawa, 3 HTBA  
CBIO 600 01 (14007) Frontiers in Medicine Fred Gorelick, James Jamieson Th 4.30-6.00  
MB&B 800 01 (14587) Adv Topics Molecular Medicine Susan Baserga, Konigsberg M 11.00-1.00  
**(PLEASE NOTE: you must also let Leigh Cromley know that you want to take the advanced class).**
NSCI 501 01 (CRN) Principles of Neuroscience DiLeone, Louvi T/F 2:15-3:45 (for those interested in Neuroscience)

**B&BS 501: Responsible Conduct of Research:** You will register for this in the Spring, however, there is ONE session in the Fall. **September 27th:** 9 a.m.

Cell Biology 600/601: “Frontiers in Medicine,” a graduate credit course for first-year MD-PhD students and an elective course for medical students, emphasizes the connections between basic and clinical science, human physiology and disease. It parallels the content of Yale Medical School’s first-year courses and is designed for students who are considering a career in medical research or who choose to explore scientific topics in depth, learn about cutting-edge research and improve their presentation skills. Discussions cover the challenges faced in research, selecting your topic and pursuing an academic career. Enrollment is limited to those who have taken or are taking the Masters Courses. Select topics are presented by eminent faculty who serve as excellent role models for your academic careers. In most sessions, 2 students review relevant manuscripts under the guidance of a faculty mentor and present the material to the group. Prior to the start of class, students are required to submit questions concerning techniques and concepts that may not be clear from the assigned papers. These questions will then be addressed during the presentation. Student evaluations are graded on attendance, participation in group discussions and formal presentations. The course runs from September to mid-May and provides graduate credit if needed. The organizational meeting and introduction is Thursday, August 31 at 4:30 pm (most sessions will be in Hope 203 at YSM). The class will meet on most Thursdays until mid-May from 4:30 -6:00pm. Fred Gorelick, George Lister, Karin Finberg, and Jonathan Bogan are organizers. Durga Thakral, Rebecca Treger, and William Culligan are MD-PhD students and will be our TAs in respective order. Yolanda Quiñones is the course coordinator (Yolanda.Quiñones@yale.edu).

**NBIO 701 [01]/NSCI 701 [01], Principles of Neuroscience** Ralph DiLeone, Angeliki Louvi
General neuroscience seminar: lectures, readings, and discussion of selected topics in neuroscience. Emphasis is on how approaches at the molecular, cellular, physiological, and organismal levels can lead to understanding of neuronal and brain function. T,F 2:15–3:45

**PATH 650b, Cellular and Molecular Biology of Cancer** David Stern, Qin Yan
A comprehensive survey of cancer research from the cellular to the clinical level. The relation of cancer to intracellular and intercellular regulation of cell proliferation is emphasized, as are animal models for cancer research. Background in molecular genetics and cell biology is assumed. Open to advanced undergraduates with permission of the organizers. MWF 1–2

**PATH 690a, Molecular Mechanisms of Disease** Narendra Wajapeyee and Demetrios Braddock
This course covers aspects of the fundamental molecular and cellular mechanisms underlying various human diseases. Many of the disorders discussed represent major forms of infectious, degenerative, vascular, neoplastic, and inflammatory disease. Additionally, certain rarer diseases that illustrate good models for investigation and/or application of basic biologic principles are covered in the course. The objective is to highlight advances in experimental and molecular medicine as they relate to understanding the pathogenesis of disease and the formulation of therapies. T-TH 2–3:30

**MB&B 800 [01], Advanced Topics in Molecular Medicine** Susan Baserga, William Konigsberg.
The seminar, which covers topics in the molecular mechanisms of disease, illustrates timely issues in areas such as protein chemistry and enzymology, intermediary metabolism, nucleic acid biochemistry, gene
expression, and virology. M.D. and M.D./Ph.D. students only. Prerequisite: biochemistry (may be taken concurrently).

NSCI 510b/NB 500b, Structural and Functional Organization of the Human Nervous System
Charles Greer, Michael Schwartz
An integrative overview of the structure and function of the human brain pertaining to major neurological and psychiatric disorders. Neuroanatomy, neurophysiology, and clinical correlations are interrelated to provide essential background in the neurosciences. Lectures in neurocytology and neuroanatomy survey neuronal organization in the human brain, with emphasis on long fiber tracts related to clinical neurology. Two-hour laboratory sections in close collaboration with faculty members. Lectures in neurophysiology cover various aspects of neural function at the cellular level, with a strong emphasis on the mammalian nervous system. Clinical correlations consist of regular sessions given by one or two faculty members representing both basic and clinical sciences. These sessions relate neurological symptoms to cellular processes in various diseases of the brain. Variable class schedule; contact course instructor. Registration for this course is by permission of the instructor.

STAT 645 [02], Statistical Methods in Genetics and Bioinformatics
Hongyu Zhao
Introduction to problems, algorithms, and data analysis approaches in computational biology and bioinformatics; stochastic modeling and statistical methods applied to problems such as mapping disease-associated genes, analyzing gene expression microarray data, sequence alignment, and SNP analysis. Statistical methods include maximum likelihood, EM, Bayesian inference, Markov chain Monte Carlo, and some methods of classification and clustering; models include hidden Markov models, Bayesian networks, and the coalescent. The limitations of current models, and the future opportunities for model building, are critically addressed. Prerequisite: STAT 538a, 542b, or 661a. Prior knowledge of biology is not required, but some interest in the subject and a willingness to carry out calculations using R is assumed.

CB&B 740 [01], Clinical and Translational Informatics
Richard Shiffman, Michael Krauthammer
The course provides an introduction to clinical and translational informatics. Topics include (1) overview of biomedical informatics, (2) design, function, and evaluation of clinical information systems, (3) clinical decision making and practice guidelines, (4) clinical decision support systems, (5) informatics support of clinical research, (6) privacy and confidentiality of clinical data, (7) standards, (8) issues in defining the clinical phenotype, and (9) topics in translational bioinformatics. Permission of the instructor required.

CB&B 752 [01]/CPSC 752au/MB&B 752au/MB&B 752au/MB&B 752au, Bioinformatics: Practical Application of Simulation and Data Mining
Mark Gerstein
Bioinformatics encompasses the analysis of gene sequences, macromolecular structures, and functional genomics data on a large scale. It represents a major practical application for modern techniques in data mining and simulation. Specific topics to be covered include sequence alignment, large-scale processing, next-generation sequencing data, comparative genomics, phylogenetics, biological database design, geometric analysis of protein structure, molecular-dynamics simulation, biological networks, normalization of microarray data, mining of functional genomics data sets, and machine learning approaches for data integration. Prerequisites: biochemistry and calculus, or permission of the instructor.
Medical School Curriculum

During Year One, you will begin Integrated Basic & Clinical Science Curriculum, which includes eight Master Courses, three Longitudinal Courses, and nine Longitudinal Threads spread out over the first eighteen months of study for all medical students:

For a complete view of the curriculum, please go to https://medicine.yale.edu/education/curriculum/integrated/

Lab Rotations
- Every student should plan on doing two 6-week laboratory rotations during the summer after the first year.

Selecting the labs in which you will rotate is one of the most important things you will do during your first year. There will be many opportunities to inform your selection. For example, when invited, attend Departmental Retreats. These provide unique opportunities to meet faculty in a relaxed setting and learn about their work. Also, contact potential mentors to meet them, their lab members and attend their lab meetings.

Year Two: You will complete coursework in the medical school premedical curriculum.

Spring Semester of Year Two:
- All students must engage in 6 months of clinical clerkships. Any exceptions to this policy must be confirmed by Dr. Kazmierczak and conveyed to Cheryl. (See MD-PhD Students and Clerkship Requirements at page 34.)

- We expect students to take Step I in the summer between Y2 & Y3, before joining your Ph.D. Lab. Step I of the Board must be taken by December 31st.
• Meet with the Director of Graduate Studies when you have made a decision about the lab where you want to affiliate to make sure your thesis advisor and department are compatible.

**Year Three:**

• By July at the start of the third year, a thesis lab should be identified and all paperwork should be completed (affiliation form completed and submitted to the MD-PhD Office).

The student begins Graduate School courses. You must meet with the Director of Graduate Studies (DGS) of the Ph.D. department to discuss the timing and protocol for the qualifying exam, which is separate from course examinations, and other requirements for admissions to candidacy.

Please be aware that there is a residency requirement imposed by the Graduate School. Students seeking the Ph.D. degree are required to be in residence in the New Haven area during at least three academic years. Any exception to the residency requirement must be approved by the Ph.D. department and by the appropriate associate dean.

**Summary Points:**

• Students should complete two 6-week laboratory rotations during the summer after the first year.
• Step I of the Board examination should be taken during the summer after Y2
• By the end of the 2nd year, a thesis lab should be identified and paperwork processed
• Students begin their third year as graduate students affiliated with a PhD department and lab. Students must speak with their DGS to confirm remaining course requirements for the PhD and to follow the department’s schedule for the qualifying exam.

**Year Four:**  MD-PhD continue thesis research. **You must satisfy the 2 Honors requirements for the Graduate School by the end of the year.** Students complete their TA requirements during this year and are encouraged to prepare and submit a NRSA F30 fellowship proposal. This must be submitted within 48 months of matriculation at Yale, so plan accordingly. The thesis prospectus must be approved and submitted to the Graduate School by the end of the second year of affiliation, i.e. the end of Spring Semester of Year Four. When the Thesis Committee approves the Prospectus, required paperwork is delivered to the PhD department so the department can complete the Admission to Candidacy paperwork and submit it to the Graduate School. The Prospectus must be submitted to the Graduate School at least six months before the dissertation is submitted.

Each student must complete the Qualifying Examination within one year of laboratory/program affiliation, *i.e.*, by the fall semester of Year Four. This is a Graduate School rule and failure to comply may prevent Graduate School registration for the following semester. Your thesis prospectus must be approved and submitted by the end of Year Four.

**Year Five to Completion of Thesis:** MD-PhD students take courses in the Graduate School and continue thesis research.

Typically an MD-PhD student will complete and defend the dissertation during fall semester of Year Six. A copy of the dissertation should be provided to the MD/PhD Program Office.

• **MD-PhD students must have their written thesis submitted and approved and defend their dissertation before returning to fulfill the remaining Medical School clinical requirements.**
• **Keep in mind that submission of a 1st author peer reviewed scientific manuscript is the minimum expectation for all students by the time of graduation.**
The Program has two mechanisms for monitoring the student’s progress in the lab: (a) bi-annual advisor reports containing a checklist of academic requirements for the Ph.D., including thesis committee meetings; and (b) assigning an Associate Director of the MD/PhD Program to attend at least one thesis committee meeting annually and in the final research year, sit as a member of that student’s thesis committee. We have asked each MD/PhD student to contact the assigned Associate Director and include him/her in the thesis committee meetings.

Failure to meet academic deadlines can lead to a student’s dismissal from the Graduate School and therefore the Program. Be professional and prompt in responding to all correspondence and inquiries from the MD/PhD program and Graduate School staff.

**Summary Points:**

- MD/PhD students must have their written thesis submitted and approved and defend their dissertation prior to re-entry to the wards.
- The Program monitors student’s laboratory progress through: i) bi-annual advisor reports and ii) assigning an Associate Director of the Program to each thesis committee.