ADDITIONAL EDUCATIONAL INFORMATION (by Richard Steinman MD PhD, Director MSTP, Steinman@pitt.edu)

A. University of Pittsburgh-Carnegie Mellon University MSTP Structure. MSTP students in Pittsburgh complete a MSTP-specific enrichment curriculum beyond the standard courses in medical and graduate school. This consists of 3 summer research rotations, 3 summer professional development courses, a 3-semester weekly journal club featuring research papers consistent with the coincident SOM curriculum, a 4-week case-based ethics course, a monthly program-wide workshop, a 40-week longitudinal clinical clerkship (1/2 day/week) during the graduate years, and yearly special events such as the two-day MSTP Scientific Retreat.

B. Laboratory Research Rotations. Research rotations begin the summer prior to the start of medical school. In addition to developing manuscripts and presenting at scientific meetings based on their rotation results, all students turn in a written scientific report that is reviewed by MSTP leadership and present their work at the annual MSTP Scientific Retreat. The choice of thesis laboratories by students is informed by their rotation history and by discussion with their individual Career Advisors (who follow them longitudinally in the program).

C. Professional Development. Students take three successive 10-week long Professional Development Courses during summers prior to starting graduate school. The first course (PD1) focuses on scientific writing and introduces students to biomedical software and to key methods used by different disciplines to approach scientific problems. The PD2 course focuses on scientific design and career development strategies, with particular emphasis on reproducibility and biostatistics. The PD3 course focuses on grant review and writing.

D. Training in Reproducibility in Science. The PD2 course focuses on optimizing reproducibility of findings, to power experiments, and analyze data with appropriate statistical testing. Topics for classes include problems arising from non-reproducible work, optimal experimental and reagent documentation and handling, the ARRIVE guidelines for animal work, measurement validity and sources of error, robust hypothesis testing, and a series of sessions on biostatistics including customized problem solving tied to student data.

E. Biomedical and ethical expertise. During MS1 and 2 years, students build biomedical knowledge through a 3-semester MSTP literature review course in which students present papers after formal consultation with local faculty experts in the field of that paper. During the G1 year of graduate school, MSTP students take a month-long, weekly, case-based research ethics course. Throughout both medical school and graduate school, all MSTP students meet monthly for student-arranged seminars that pose scientific, logistical, clinical and/or ethical dilemmas. These workshops are presented by students and/or guest faculty experts.

F. Clinical and Research Integration. This is a central focus to better model the physician scientist career.

F.1 Clinical Activities During the Research Years: Prior to starting graduate school, all of our MSTP students complete 8 weeks of required clinical core clerkships. This front-loads requirements once students re-enter medical school post thesis and enables research engagement in MS3 and 4. MSTP students are required to complete a (credited) minimum of two 20-week long Longitudinal Clinical Clerkships during graduate school. For each LCC, students spend a half day per week with a clinician scientist receive one-on-one clinical mentoring by a clinician scientist in an area of interest chosen by the student with guidance from the MSTP LCC director, Paul Monga, MD. Student objectives for the LCC and write-ups at the end are reviewed by MSTP leadership.

F.2 Transition from Graduate to Clinical Years. During our MSTP Clinical Reentry elective, a master clinician mentors the returning students once weekly over the month prior to reentry as they examine, discuss, diagnose and plan treatment for surrogate patients presenting with common outpatient or inpatient ailments.

F.3 Research During Clinical Years. Our students continue their research focus after re-entry to medical school generally in four ways: (1) MS3 and MS4 students continue to plan and execute MSTP Workshops that feature research topics and research challenges to be discussed with MSTP peers. (2) Students complete formal reflective and goal-oriented self-assessment evaluations during twice-yearly Career Advisor meetings. (3) Students average 2.8 new publications during the MS3 and MS4 years (at least one first authored), averaging 5-7 papers upon graduation. (4) Most students elect to take 1-2 Research Elective months during their MS4 year to extend findings of thesis work and/or to build skillsets in a translational area. Another novel feature of our MSTP, the Postdoctoral Fellowship, provides support for 5 months of postdoctoral research prior to residency for MSTP students graduating in December (25% of graduates in recent years). Applications address research hypotheses and aims, career development aims, planned deliverables, mentor fit, and intellectual goals.

G. Monitoring and Evaluating Student Progress. Prior to matriculation, the Program Director assigns each new student a Career Advisor based on matching research interests who helps orient and guide the student

throughout their career. Most of a trainee's time in the graduate program is spent in research training under the guidance of their research mentors, program leadership, and eventually their doctoral dissertation committee. To customize advice and resource allocation, all MSTP students complete and share *individual development plans* with the Director and with their Career Advisor. The form allows students to identify specific skills that they want to develop; to set technical, intellectual and professional goals; and to identify how goals will be achieved and measured. Resources to reach goals and obstacles that could compromise success are enumerated and discussed. Progess toward goals is regularly reviewed with the Advisor and new goals are set.

H. Career Counseling. To better reflect the student's educational experience to prospective residency programs, the MSTP creates an executive summary which describes student evaluations, honors, presentations and participation in the combined degree training, rewarding students who altruistically give their time and demonstrate prowess in working in groups. Six months to one year before completing their doctoral program, students meet with the Program Director and the Career Advisory committee to discuss postgraduate training, residencies, fellowships, and faculty positions and non-academic based positions. Many of the faculty are MD/PhDs and are capable of participating in career planning for third and fourth year medical students.

I. Program Duration and Outcomes. Over the past 5 years, our time from enrollment to graduation has averaged 7.7 years (8.1 years in the prior 5-year period). The Pittsburgh MSTP has 170 alumni. 89% of graduates from the past 15 years are in the academic pipeline (either still in training or in academic positions). Graduating MSTPs in 2011-6 averaged 6.2 papers/student (3 first authored) and 47% had obtained F-grants.

J. Joshua Wesalo is a stellar member of our MSTP who matriculated into the MSTP program in June 2014 and is in his G1 year as a graduate student in the Chemistry graduate program. He is pursuing his doctorate in the laboratory of Dr. Alex Deiters, a highly respected expert in synthetic and opto-chemical chemistry applied to biological systems. Josh's outstanding performance in the MSTP to date is described in the Letter of Recommendation from the MSTP Director. Josh completed his MS1 and MS2 coursework and passed USLME Step 1 in April 2016. He completed the MSTP Professional Development courses, 3 laboratory rotations (2 in the laboratory of Dr. Deiters), Research Basis of Medical Knowledge courses, and an 8-week clinical rotation in neurology and psychiatry prior to beginning graduate training. Josh formally entered the Chemistry program in 2016. Over the past 5 years, he has given 5 oral presentations at 5 meetings, including *Genomic Medicine and the Plain Populations of North America*. A co-authored manuscript on the chemically-triggered control of protein SUMOylation is under preparation.

The coursework for Chemistry consists of a total of four courses. Josh has completed two courses and is completing the next two this semester. The Graduate Student Advising Committee has worked with Josh to design a unique course of study that suits the needs of a physician-scientist in training.

The Chemistry PhD has several program milestones with timelines adjusted for expeditious completion by MSTP students. Josh expects to take his Comprehensive Exam in the summer of 2018, where he will prepare a report describing his research findings thus far, and will discuss the findings and field questions from pre-selected training faculty that will eventually become his thesis committee members. Josh plans to schedule his Thesis Proposal immediately after completing his Comprehensive Exam**,** where he will propose the research aims that he will complete to fulfill his PhD. After completing his milestones, Josh will be a formal PhD candidate and his progress will be monitored at regular, biannual committee meetings as well as in biannual MSTP Career Advisor Meetings where his updated Individualized Development Plans will be reviewed. Josh expects to complete Longitudinal Clinical Clerkships in Fall 2017 and Fall 2018 during graduate school. He expects to defend his PhD and research proposal and return to medical school in Summer 2021, putting him on track to complete his remaining medical school clerkships and graduate from our program in Spring 2023. For the terms of the fellowship proposed, Josh plans to complete an additional 48 months of research, followed by clinical work for 18 months. Should Josh elect the route in which he graduates medical school in December of 2022, he will then undertake the 5 month MSTP Postdoctoral Fellowship which is not included in the time of covered support requested in the current application.

Richard Steinman MD, PhD
Director, Medical Scientist Training Program
Steinman@pitt.edu