NEW COURSES. An important goal for creating a unified training plan that encompasses dual disciplines of study will be the development of learning opportunities that have an “equal footing” in both basic laboratory sciences and population sciences. To achieve this goal, we will offer three new courses, outlined below.

- **IND 419 - Introduction to Quantitative Biology (3 credits)**. Rapid advances in technology are driving the collection of ever-increasing data sets at rapidly declining cost – resulting in new opportunities to understand biology and disease. This course will provide entering graduate students with a practical understanding of tools and approaches to the analysis and interpretation of high-dimensional biomedical data sets, including data that span basic laboratory and population sciences. Lecture topics will include: Essentials of NCBI and UCSF Browser Workshops, Transcriptomics, Microbiomics, Proteomics, Genomics, Epigenetics, Statistics, and Cytometry among other current topics. We will emphasize critical thinking and reading of the primary literature to understand original experiments, rather than abstract facts and memorization. Classes will be held 3 times per week and each topic section will include a journal club where students will present relevant papers. At the end of this course, students should have a deeper understanding of the computational tools involved in the analysis of high volume biological data, focusing on web-based resources but also introducing core approaches in bioinformatics.

- **MBI 411 - Epidemiology of Infectious Diseases (2 credits, spring)**. Despite advances in vaccine biology, drug therapy and disease surveillance, infectious diseases remain a major cause of morbidity and mortality among populations. This new course will introduce the basic methods for infectious disease epidemiology and provide case studies of important pathogens and disease syndromes. Course concepts will include: definitions and nomenclature, outbreak investigations, disease surveillance, case-control studies, cohort studies, laboratory diagnosis, molecular epidemiology, dynamics of transmission, and assessment of vaccine effectiveness. Case studies will include acute respiratory infections (influenza), pneumococcal infections, diarrheal diseases, hepatitis, HIV, tuberculosis, sexually transmitted diseases, and malaria.

- **MBI 412 - Population & Laboratory Approaches to Infection & Immunity (1 credit, fall and spring)**. This course will provide IIMP graduate students with a forum for presenting and discussing their planned and ongoing research projects in great depth with their student peers - including the underlying basis for their studies, experimental design, data interpretation, future studies, and challenges encountered in the execution of their studies. The course will be facilitated by a program faculty member with the goal to provide students with a self-directed learning environment, and to encourage participation in a “safe”, lower-stakes setting, such that students will be less inhibited to ask questions and discuss their ideas. This new course is also expected to provide students with an opportunity to begin the process of developing a “personal research network” by actively interacting with their colleagues, which will be essential for future success in their research careers. The students will meet at least seven times each semester, for 90 min. Students in their first 2 years of the program will deliver informal work-in-progress presentations intended to build confidence and develop critical thinking skills; more advanced students will deliver more formalized presentations intended to build experience in giving oral research seminars.

These new courses will provide IIMP students: 1) an appreciation for the dual discipline focus of the IIMP program; 2) a broad understanding of the population health impact of infectious pathogens; and 3) scientific critical thinking skills, including understanding the methodology, analysis approaches and interpretation of their dissertation research projects.

EXISTING COURSES. These courses are required for all TBS program trainees to ensure that each student has the basic skills for a successful career, including instruction in the responsible conduct of research, and training in scientific presentation and writing skills. TBS and TBS-IIMP PhD students will take the grant writing class in the spring of their second year, where they will write and submit an individual predoctoral fellowship award or a pilot proposal to an extramural sponsor (NIH or a private foundation).

- **IND 501 - Ethics and Integrity in Research (1 credit)**. All entering graduate students (and other researchers new to URM) must receive training in the responsible conduct of research. Thus, all IIMP students will take this 8-week ethics course, which consists of a weekly series of one-hour lectures, each followed by a one-hour small group discussion with case studies to assess various examples of ethical issues in biomedical research. Lecture topics include: Introduction to Ethical Issues of Biomedical Research, Human/Clinical Data & Conflict of Interest, Plagiarism, Animal Research, Team Science & Collaboration, Publication Process, Stem Cell Research, and Mentor-Mentee Relationships. Senior faculty and deans lead the lectures and experienced PhD mentoring faculty facilitate small group discussions. Ongoing training in responsible conduct of research occurs through yearly seminars sponsored by the CTSI, the Office of Graduate Education, and from regular interactions with research mentors. Topics such as conflict of interest in the publication and peer-review process, authorship and plagiarism are reviewed in the Workshop on Scientific Communications (IND 417) and ethics in grant writing and grant reviewing are covered in the Practical Skills in Grant Writing (IND 438). Training and certification in Human Subjects Protection and Use and Care of Vertebrate Animals is also required.
• IND 417 - Workshop in Scientific Communications (1 credit). This is a skills-based workshop aimed at improving scientific communication. The focus is on clear and concise scientific writing, submission to and publication in scientific journals, the use of digital resources and bibliography software, building skills to give effective oral presentations and creating visually informative posters. Each student will complete one writing/presentation assignment during the class.

• IND 438 - Practical Skills in Grant Writing (3 credits). Course content includes didactic lectures on grant-related topics, opportunities to examine grants that others have written, examination of tools and resources available to assist in grant writing, and the requirement to write a grant application for the support of the trainee’s own research project and have it critiqued. This course focuses on how to find appropriate grant funding opportunities, the fundamentals of grant requirements (including foundations, NIH, non-NIH federal agencies). At the end of the course, the enrollee should be able to write and peer-review a research grant application.

• PM 476 - CTSI Seminar Series (all semesters, all years). A weekly seminar series that includes presentations from UR faculty, guest lecturers and experts in technological innovations. Seminar topics focus on translational aspects of both laboratory and population science. Monthly, one seminar is devoted to training in responsible conduct of research.

Additional Advanced Training Opportunities.

• Immersive Cross-disciplinary Internships. To ensure that our trainees become familiar with the culture and methods of approach in both laboratory and population sciences, in the second year each student will cross-train in population and laboratory sciences (and vice versa) for a full semester under the mentorship of each of their discipline-specific primary advisors. This will allow the students to learn and demonstrate their skill in both laboratory and population sciences, and to create interdisciplinary, team-oriented researchers with competencies necessary for “non-traditional” collaboration.

• Immersive Cross-disciplinary Externships. Optional externships will be offered to program trainees, to provide experiences of 8-12 weeks duration in “real world” settings in which future career path opportunities may be identified. These externships will allow students to spend up to 3 months outside the UR, learning hands-on skills in foundations, county, government or private sector settings. The IIMP Steering Committee will select candidates based on established criteria.

• Annual Research Retreat in “Population and Laboratory Approaches to Infection and Immunity.” An annual research retreat will be held each year in June. The retreat will feature a keynote lecture by an outside speaker and short oral presentations by current IIMP trainees. In addition, we will feature cross-disciplinary research by opening up the poster session to other faculty and pre- and post-doctoral trainees at URMC who have formed interdisciplinary research teams to synergize their research efforts. An afternoon social/interactive session will also be included, to facilitate networking.

• Mentor-Protégé Writing Course (IND 414, 3 credits; elective). The course is designed to teach mentors to effectively and efficiently teach scientific writing and to provide the basics of scientific writing to protégés. The course complements Practical Skills in Grant Writing and Scientific Communications courses. Mentors and trainees start with a series of classes on the fundamentals of good writing and end by completing their own grant application or manuscript.

Informal Educational Opportunities

• “Career Stories” Seminar Series (4 per year) is specifically designed to familiarize trainees and faculty with the career paths of scientists working at the interface between population and laboratory-based sciences. We will bring in successful scientists (including UR alumni) to share their transitions and triumphs. These seminars will be guided interviews that use a common structure (including: personal background & training; reasons for pursuing career choice; impact of advice and mentorship on career choices; key challenges and successes).

• Trainee autonomy and self-directed learning. All IIMP PhD students will be required to complete a DISC assessment (Dominance, Inducement, Submission, and Compliance personality inventory) to assist with self-reflection and planning. In addition, all trainees will complete an Individualized Development Plan (IDP) outlining their career goals and personal learning expectations. IDPs will serve as the guiding document to chart goal setting, progress and performance. This validated instrument is a comprehensive evaluation tool that solicits from each learner their career goals and then deconstructs knowledge, skills and values necessary to achieve those goals. This active document will be reviewed with the co-mentors and assigned IIMP Program Mentor annually, serving as a needs assessment for the mentors to identify the skills and knowledge that the learner will acquire in the coming academic year. The IDP also serves as a written contract of goals and reflection. We expect that at each review meeting, goals will be revised to reflect the learner’s growth over time.

• Leadership Academy Program. Professional/career development resources in the URMC Office of Human Resources (OHR) will be made available to IIMP trainees, with the goal of providing structured instruction in “soft skills” in leadership and professionalism that are otherwise neglected in traditional graduate curricula. The URMC OHR is running a URMC Leadership Education and Development (LEAD) Program. This program provides access to in-depth, high quality online instruction from national leaders in business and healthcare. This leadership program incorporates self-reflection, mentorship,
and instruction and application to achieve individualized learning goals. It also provides structured educational content – including key concepts and case studies – combined with self-evaluation and assessment tools. After students complete the introductory module “Foundations of University Leadership”, specific learning modules will be assigned to IIMP trainees.

- **Scientific Collaboration Emporium (4 per year).** Faculty from laboratory and population sciences whose research interests in infection and immunity are potentially complementary (and may therefore lead naturally to collaborations) will be invited to present their research to like-minded colleagues and students, with the goal of identifying areas for mutual collaborations. Additional faculty and students who express interest, but are not ready to present their research in this forum will also be invited to attend. Exposing interested and curious faculty and students to potential areas for collaboration will raise awareness of the new IIMP training pathway, promote new collaborations between population and laboratory scientists, and lead to recruitment of new students and faculty into the IIMP program.

- **Interdisciplinary Pilot Award Program.** To increase awareness of the IIMP program, and to promote new collaborations between laboratory and population science investigators, we will create a competitively awarded, pilot award funding opportunity to which predoctoral trainees may apply. These pilots are intended to “transform” research approaches by having current predoctoral students incorporate dual laboratory and population training in their dissertation research. A key goal will be to increase awareness of the IIMP program, and to foster new research collaborations between faculty members in the population and laboratory sciences – thereby laying the groundwork for future expansion of the IIMP program. This pilot program is currently under development.

**Lab Rotations, Mentor Selection and Qualifying Examinations**

- **Lab Rotations and Mentor Selection.** All trainees will be required to complete three 8-week research rotations during their 1st year of graduate training. PhD trainees usually select their primary mentor after three rotations in May or June of the 1st year. Because IIMP students will need to find two mentors from two disparate disciplines, they may select a 4th rotation for the first summer to accrue two mentoring experiences for lab and population science. This approach may facilitate finding compatible co-mentors as well. However, should the IIMP student find a research “home” with co-mentors from both disciplines after two rotations, the 3rd rotation will be waived. IIMP students will be introduced to rotation opportunities by attending the “Meet Prospective Mentors Mini-Seminar Series.”

During the first 7-10 weeks of the fall semester, incoming IIMP students (and interested other students) will attend the mini-seminar series, which will consist of 20-30 min presentations by each mentor with two or three mentors presenting per weekly session. The first lab rotation starts in the 6th week of the fall semester. Prospective mentors will describe the research focus and projects available in their labs that fit the dual discipline approach; the goal will be for 1st year students to select three potential lab rotation mentors. We will ask all prospective mentors to attend as many sessions of this “Meet Prospective Mentors” mini-seminar series as possible, especially in the first two years of the program, with the goal that the mentors are better informed of the potential collaborations that may be established. Additionally, collaborative efforts will be established as outcomes of the quarterly “Scientific Collaboration Emporium.” The outcomes of this “Meet Prospective Mentors” mini-seminar series will be two-fold: 1) selection of three lab rotation assignments (optional 4th rotation in Yr-01 summer); and 2) the mentors will establish new collaborations at the interface of infection and immunity and population science research.

- **Structure and Focus of Qualifying Exams (QE) (complete by October of program Yr-03).** Students completing the IIMP program will receive the New York State accredited PhD in Translational Biomedical Science (TBS). Thus, the format and structure of the QE will follow the TBS program. Because of the dual discipline focus of the IIMP program pathway, we will add two additional requirements to the structure of the QE for IIMP trainees. First, in addition to the required number of thesis committee members (four, inclusive of the two co-mentors), IIMP trainees will include a representative from the community (non-voting) to gain the “real world” perspective from individuals who work at the population level with persons affected by the disease or area of research of the student’s dissertation project (including patient advocates). Because we have deep ties with the community and many of the organizations that support and represent patients, we will draw on existing partnerships. Second, we will introduce a written assessment of the student’s competency in both laboratory and population based sciences at the end of the 2nd year when the student has completed both semester-long Immersive Cross-disciplinary Internships (See Example Program of Study).

After passing the written assessment (May/June program Yr-02), students will prepare the written thesis proposal in the style of an NIH-R01 grant. At the QE (Sept/Oct program Yr-03), the thesis committee members will be expected to ask questions that test the student’s general knowledge of subject matter learned from course work, important basic knowledge about the disease and comorbidities found in the patient population and basic science field under study, and questions about the design of the proposed research and how the outcome of the study would lead to the next study. Faculty may ask the student how to design a related study that is not part of the thesis project so the committee members can assess the depth and breadth of the student’s knowledge in performing research in both laboratory and population sciences.