MSTR 5100 Introduction to Clinical and Translational Research
This introductory course lays the foundation for understanding practical aspects of conducting clinical research in an academic environment. The course is divided into two modules: Module 1: Research Methods & Protocol Development and Module 2: Regulatory Environment for Clinical Trials. The first module introduces clinical research, clinical protocols, study designs and biostatistics that underlie such studies. The second module covers ethical considerations in clinical research, study execution and oversight, and the regulatory environment for clinical research. Upon completion, students should have a strong foundation in the fundamentals of clinical research and should be able to apply contemporary research tools to clinically relevant areas of investigation. Prerequisite: This course requires permission to register. Please contact Bethany Germany at (bgermany@upenn.edu) to register.
Fall
Also Offered As: REG 5100
1 Course Unit

MTR 5350 Introduction to Bioinformatics
This course provides overview of bioinformatics and computational biology as applied to biomedical research. A primary objective of the course is to enable students to integrate modern bioinformatics tools into their research activities. Course material is aimed to address biological questions using computational approaches and the analysis of data. A basic primer in programming and operating in a UNIX environment will be presented, and students will also be introduced to Python, R, and tools for reproducible research. This course emphasizes direct, hands-on experience with applications to current biological research problems. Areas include DNA sequence alignment, genetic variation and analysis, motif discovery, study design for high-throughput sequencing RNA, and gene expression, single gene and whole-genome analysis, machine learning, and topics in systems biology. The relevant principles underlying methods used for analysis in these areas will be introduced and discussed at a level appropriate for biologists without a background in computer science. The course is not intended for computer science students who want to learn about biologically motivated algorithmic problems; BIOL 4536/BIOL 5536 and BE 5370/CIS 5370/MPHY 6090 are more appropriate. Prerequisites: An advanced undergraduate course such as BIOL 4210 or a graduate course in biology such as BIOL 5210, BIOL 5240, or equivalent, is a prerequisite.
Fall
Also Offered As: CIS 5350, GCB 5350
1 Course Unit

MTR 6010 Review Writing
This course will lead students through the process of writing a review article during their first summer in the MTR program. Review articles will be authored with the student's primary mentor and will be used to accomplish the following goals: 1) attain rapid familiarity with background in their new area of study; 2) a mechanism for mentor and student to create a productive working/writing relationship; 3) help the student identify key gaps in the literature and/or areas of controversy that would benefit from pivotal experiments; 4) understand the factors that contribute to variability in research outcomes in their area and; 5) introduce the student to other scientists in their new area through an initial publication early in their career. Mentors will be asked to agree to participate in this process, or identify another senior individual in their group who would perform the function. The course director will provide guidance and critical reviews throughout the process.
Summer Term
1 Course Unit

MTR 6020 Proposal Development and Study Design
This course has two primary areas of focus: (i) proposal development and enhancement; and (ii) a focus on research and study design. (i) Proposal Development and Enhancement: Students apply foundational concepts by revising and refining their written proposal and presenting their research project throughout the course. Students receive an overview of approaches to developing an effective proposal; and guidance on how to write and present their hypothesis, specific aims, research strategy, significance, innovation, and approach using the general NIH application format. (ii) Research and Study Design: Students receive an overview of translational research principals and clinical study design approaches relevant to thesis projects designed to probe mechanisms of disease and translate results in basic research into investigations in humans. Topics include clinical and translational research methods, and study design and execution. Students are introduced to these topics through asynchronous and synchronous learning environments. At the end of the course, each student submits and presents their written proposal to their peers and a panel of reviewers for critique and feedback. Members of the panel include the students’ research mentor(s), program mentor, and thesis committee. The panel provides feedback on the proposal which the student will then incorporate into the written proposal. Students submit their final revised proposal to be reviewed and graded by their program mentor.
Fall
Also Offered As: REG 6020
1 Course Unit

MTR 6030 Disease Measurement
Students will acquire the knowledge to effectively incorporate disease measurements into the design of clinical and translational research protocols, gain a basic understanding of measurement methodologies used in clinical medicine, understand how "normal" values are determined, and how to interpret test results in the context of patients/research subjects. Students will also approach disease measurements as a mean of answering questions, and be able to choose appropriate tests to answer the question posed. The measurement aspects of the student research protocols are evaluated during this course. The course is separated into lab and imaging sections, with common introductory lectures.
Fall
1 Course Unit
MTR 6040 Scientific & Ethical Conduct
In this course, students will learn the foundational principles of scientific, operational and ethical conduct of research, complete directed experience in evaluating ethical principles through IRB membership and ultimately be able to apply all principles to their own work. By the end of the foundational class sessions, students will understand scientific conduct, ethical considerations of human subject's research, good clinical practices (GCP), good laboratory practices (GLP), conflict of interest, and budgetary concepts. The directed experience will include becoming a member of an Institutional Review Board (IRB) (Penn or CHOP) and participating as an active member in 6 meetings.

Spring
Also Offered As: REG 6040
1 Course Unit

MTR 6050 Data Manuscript Writing
Students will write a primary data manuscript for publication with their primary lab mentor. Emphasis will be placed on identifying publishable data that was either generated by the student, or which is made available to the student for analysis from the mentor's lab. The student will be expected to learn the role of first author including 1) coordination with the senior mentor to write the introduction, 2) organize data, analyses and figures, 3) obtain or write methods and results from collaborators, 4) writing a discussion and, 5) getting it out the door. Mentors will be asked to agree to participate in this process, or identify another senior individual in their group who would perform the function as a condition to have MTR students funded in their lab. Course director and members of the curriculum committee will provide guidance and critical review of work throughout the process.

Spring
1 Course Unit

MTR 6070 Thesis I
Candidates are expected to complete a thesis that involves designing a research project, writing a formal research proposal, performing the study described in it, preparing a comprehensive scholarly scientific paper reporting the results, and presenting and defending the thesis at a public seminar. At the time of application, each candidate specifies the project they will pursue, along with the lead mentor who will supervise the project.

1 Course Unit

MTR 6080 Thesis II
Candidates are expected to complete a thesis that involves designing a research project, writing a formal research proposal, performing the study described in it, preparing a comprehensive scholarly scientific paper reporting the results, and presenting and defending the thesis at a public seminar. At the time of application, each candidate specifies the project they will pursue along with the lead mentor who will supervise the project.

1 Course Unit

MTR 6200 Medical Entrepreneurship: Commercializing Translational Science
This course provides in depth insight into the process by which health technology platforms including scientific discoveries are transformed into viable commercial entities. This includes methods to evaluate market opportunities and derisk critical assumptions within the rapidly changing academic and healthcare environment. Topics include intellectual property creation and licensing, technology transfer, regulatory pathways, raising capital/NIH SBIR/STTR grant funding, go to market strategy, market sizing, formation equity, and recruiting co-founders. The major project will involve the formation of teams that will create a defendable business plan and consummate in a presentation (pitch deck) intended to raise capital. The course will be especially valuable for students who may be considering entrepreneurial career paths including starting a company, working for an early stage venture, healthcare consulting, or assuming innovation leadership roles.

Spring
Also Offered As: BE 6080
1 Course Unit

MTR 6210 Cell and Gene Therapy
This course will provide students with a general overview of translational research in the area of gene and cell therapy. This includes technical considerations, translating preclinical investigation into therapeutics, the execution of gene and cell therapies clinical trials, and key regulatory issues. Entrepreneurial considerations will be discussed as well. By the end of this course, students will understand the basic technologies employed for gene and cell therapy along with approaches and pitfalls to translating these therapies into clinical applications including regulatory and commercial aspects of this emerging area. Prerequisite: For graduate students, at least one prior course in immunology. An undergraduate-level or medical school immunology course is sufficient to meet the prerequisite.

Two Term Class, Student must enter first term; credit given after both terms are complete
Also Offered As: CAMB 7070, REG 6210
1 Course Unit

MTR 6220 New Trends in Medicine and Vaccine Discovery
Modern drug discovery has evolved to include human genetic diagnosis and various biological approaches which has enabled progress in a variety of fields, including rare diseases, immuno-oncology, precision medicine, and biomarkers. The goal of this course is for students to understand newer treatment modalities and approaches beyond one size fits all small molecule drugs, as well as the technologies that empower them. Students will learn regulatory processes that govern medicine discovery and development and also consider business and societal aspects of medical progress. Students will be able to apply concepts directly to work in the healthcare industry. Students will be taught by experts in the field internal and external to Penn. Prerequisite: Permission required to register. Please contact Rachel McGarrigle (rmcg@upenn.edu) to request a permit.

Fall
Also Offered As: REG 6220
1 Course Unit
MTR 6230 Writing an NIH Grant
This course will provide a comprehensive overview of the grant writing process: fundamentals of good grant writing, general preparation of grant application (e.g. specific aims, research strategy, budgets, analysis of reviews and strategies of rebuttal and re-application), identifying RFAs, study sections, program officers and Scientific Review Officers (SROs), research strategy and detailed descriptions of the different types of funding mechanisms (R01, R21, K99/R00). The two mock study sections – one consisting of peers and the other of faculty – is expected to familiarize the participants with the NIH review process. This course is expected to provide the foundation of any grant proposal, in terms of writing skills. It will be mandatory for all students to submit the intermediate proposals, and the final proposal. The participants will be drafting, revising, and working one-on-one with their peers and the course director to improve their proposal. The course will provide hands-on experience drafting the specific aims, significance, and innovation sections, through peer and faculty evaluation. Audience: Faculty and postdocs who have not written an NIH grant before or need guidance. Advanced graduate students may be permitted to enroll.
1 Course Unit

MTR 6400 Seminar in Entrepreneurial Science
Seminar in Entrepreneurial Science. Permission from department required to enroll.
Fall
0.5 Course Units

MTR 9999 Master of Science in Translational Research LAB
1 Course Unit