MTR 510 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.
Taught by: Emma Meagher, MD
Course usually offered in fall term
Also Offered As: REG 510
Activity: Lecture
1.0 Course Unit

MTR 535 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 437/GCB 536 and GCB/CIS/CIS 537 are more appropriate. Prerequisites: An advanced undergraduate course such as BIOL 421 or a graduate course in biology such as BIOL 526 (Experimental Principles in Cell and Molecular Biology), BIOL 527 (Advanced Molecular Genetics), BIOL 540 (Genetic Systems), or equivalent, is a prerequisite.
Taught by: B Voight, C Greene
Course usually offered in spring term
Also Offered As: CIS 535, GCB 535, PHRM 535
Prerequisite: BIOL 421 OR BIOL 526 OR BIOL 527 OR BIOL 528 OR BIOL 540
Activity: Lecture
1.0 Course Unit

MTR 600 Introduction to Biostatistics
This course approaches statistics from an applied as well as theoretical point of view. Students learn the correct application and interpretation of basic statistical concepts and techniques. The course covers probability estimation, hypothesis testing, nonparametric tests, tests for categorical data, correlation, and regression.
Taught by: Andrew Cucchiara, PhD and Kimberly Forde, MD, MHS
Course usually offered in fall term
Activity: Lecture
1.0 Course Unit
Notes: Only MTR degree and certificate students may enroll in this course.

MTR 601 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.
Taught by: Rachel Locke, PhD
Course usually offered summer term only
Activity: Seminar
1.0 Course Unit
Notes: Only MTR degree students may take this course.

MTR 602 Proposal Development
Focuses on study design and proposal development as they relate to studies that probe the mechanism of disease. Discusses concepts such as writing a background section, asking a research question, designing a study, use of biomarkers, writing a research proposal, overview of study designs addressing feasibility issues. Development of thesis proposal starts during this course and concludes with each student submitting and presenting their proposal to the MTR faculty panel for critique and feedback.
Taught by: Anil Vachani, MD
Two terms. student must enter first term.
Also Offered As: REG 602
Activity: Seminar
1.0 Course Unit
Notes: Only MTR degree and certificate students may enroll in this course.
MTR 603 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 means 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.
Taught by: David Mankoff, MD, PhD, Yong Fan, PhD, Tracey Polsky, MD, PhD, Charlene Bierl, MD, PhD
Course usually offered in fall term
Activity: Seminar
1.0 Course Unit
Notes: Only MTR degree students may enroll in this course.

MTR 604 Scientific & Ethical Conduct
In this course, students will learn the foundational principles of scientific and ethical conduct of research, complete directed experience in evaluating these principles through IRB membership and ultimately be able to apply them to their own work. By the end of the foundational class sessions, students will understand scientific conduct, ethical considerations including human subjects and animal protections, regulations governing the use of health information, drugs, and devices, good laboratory practices, conflict of interest, and ethics in challenging new research domains. The directed experience will include membership for six months on an Institutional Review Board (IRB) at either the University of Pennsylvania or the Children's Hospital of Philadelphia. This membership experience will expose students to real issues, considerations, and solutions in human subjects research and study design.
Taught by: Emma Meagher, MD
Course usually offered in spring term
Activity: Lecture
1.0 Course Unit

MTR 605 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 program. Course director and members of the curriculum committee will provide guidance and critical review of work throughout the process.
Taught by: Kachina Allen, PhD
Course usually offered in spring term
Activity: Seminar
1.0 Course Unit
Notes: Only MTR degree students may enroll in this course.

MTR 607 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.
Taught by: Emma Meagher, MD
Activity: Masters Thesis
1.0 Course Unit

MTR 608 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.
Taught by: Emma Meagher, MD
Activity: Masters Thesis
1.0 Course Unit

MTR 620 Commercializing Translational Therapeutics
To provide an in-depth view of the process by which scientific discoveries are commercialized. This course covers discovery in the laboratory, technology transfer, regulatory, financial, and managerial issues involved in moving a technology from the lab into the market place. The course contents fall into three broad categories: (1) examples of scientific discoveries that are candidates for commercialization, (2) fundamental elements of technology transfer, such as intellectual property protection and licensing, and (3) aspects of commercialization, such as regulatory approval, financing, and startup formation. In using this structure, the course provides parallel coverage of both the science and the commercialization process, in such a way that the elements of one contribute to the student's experience in learning the other. Prerequisite: Undergraduates and graduate students in other departments are welcome. Please contact mmaxwell@upenn.edu to request permission to request permission to register.
Taught by: Nalaka Gooneratne, MD
Also Offered As: BE 608
Activity: Lecture
1.0 Course Unit

MTR 621 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: At least one course in immunology.
Taught by: Michael C. Milone, MD, PhD, Elizabeth Hexner, MD, MSTR
Course usually offered in spring term
Also Offered As: CAMB 707, REG 621
Activity: Lecture
1.0 Course Unit
MTR 622 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.
Taught by: Claudine Bruck, PhD
Course usually offered in fall term
Also Offered As: REG 622
Activity: Lecture
1.0 Course Unit

MTR 623 Writing An Nih Grant
This course will provide a comprehensive overview of the grant writing process. Audience: Faculty who have not written an NIH grant before or need guidance.
Taught by: Ragini Verma, PhD
Activity: Lecture
1.0 Course Unit

MTR 999 Master of Science in Translational Research LAB
Activity: Independent Study
1.0 Course Unit