GRADUATE PROGRAMS IN
THE BIOMEDICAL SCIENCES

Graduate Education Office, School of Medicine, RM TG-1
casemed.case.edu/gradprog (http://casemed.case.edu/gradprog/)
Phone: 216.368.5655; Fax: 216.368.0795
Marvin Nieman, PhD, FAHA, Interim Associate Dean for Graduate Education
marvin.nieman@case.edu

Cheryl Thompson, PhD, Assistant Dean of Educational Initiatives
cheryl@case.edu

Malana Bey, Administrator
malana.bey@case.edu, 216.368.5655

The School of Medicine is proud to administer doctoral, master’s, professional and certificate graduate programs in the biomedical sciences, described fully in this bulletin under their departmental or center affiliations. The Graduate Education Office provides support and information on the graduate and postdoctoral training programs in the School of Medicine, as well as professional skill development and training grant proposal support. Resources for proposal development as well as current training information are available at the SOM Graduate Education Office (https://case.edu/medicine/admissions-programs/graduate-programs/) website.

Case Western Reserve University School of Medicine has a strong commitment to the importance of diversity in its research and educational programs. The CWRU community celebrates how our individual diversity in race, ethnicity, gender, country of origin, sexual orientation or gender identity enhances our work together. CWRU programs welcome diverse individuals, including those individuals of racial and ethnic groups underrepresented in biomedical science, those with physical disabilities, and those with disadvantaged backgrounds.

Common Academic Requirements
Each graduate program follows the overall regulations established and described in Graduate Studies Academic Requirements pages (http://bulletin.case.edu/schools/graduatestudies/academicrequirements/) and documented to the Regents of the State of Ohio. In particular, students and faculty are directed to sections regarding Academic Requirements for Master’s and Doctoral Degrees regarding total and graded course requirements, dissertation advisory committees, maintenance of quality-point average, and other general aspects of graduate study at CWRU. Within those overall expectations, a specific course of study for each graduate program is required and described in each degree plan of study.

Guiding Principles for Graduate Education in the School of Medicine

Training and educating graduate students in the biomedical sciences is a complex process that continually evolves based on the rapid progression of scientific discovery and ever expanding technological landscape. Graduate programs must continually modify their approaches to meet these modern-day needs. Students are expected to master their overall discipline, become experts in their field of research, as well as gain expertise in a diverse, but interrelated professional skill set. That skill set should be clearly defined, widely communicated and integrated across all PhD disciplines at CWRU SOM. Moreover, a set of common principles or goals for educating all graduate students in the SOM helps to guide our programs in course or curriculum development. The School of Medicine Graduate Education Office, in collaboration with the graduate program directors, developed a formal set of Guiding Principles (https://case.edu/medicine/sites/case.edu.medicine/files/2019-06/Guiding%20Principles_rev%202018%200.pdf) for the education and training of all PhD students in order to help accomplish these important goals.

Graduate Admissions to School of Medicine Programs

Graduate students are admitted to our programs through several streams, including the Biomedical Sciences Training Program (http://www.case.edu/med/BSTP/), the Medical Scientist Training Program (http://mstp.cwru.edu/), dual-degree initiatives, and direct admission to specific programs (please see individual program entries under their affiliated department pages). Postdoctoral Fellows and Postdoctoral Scholars are appointed through the Office of Postdoctoral Affairs (http://postdoc.case.edu/).

Student Affinity Groups

Graduate students interact in vibrant groups in the School of Medicine including:

The Biomedical Graduate Student Organization (BGSO) (https://community.case.edu/bgso/about/) seeks to unite biomedical graduate students pursuing master’s and doctoral degrees in various biomedical graduate programs in the Case Western Reserve University School of Medicine, with the ultimate goal of enriching the student experience and promoting career and professional development.

What We Do:
Promote greater career and professional development
Promote more interaction between graduates and professionals of the School of Medicine
Ease the transition into graduate school by creating a “survival guide”

Get Involved!
It’s your graduate career - why not make sure you get what you want out of it? As a graduate student, you can get involved by becoming a representative for your department or coming to monthly meetings. Please email us for more information or attend our next meeting.

Highlights include:
Hosted the following professional development seminars - “Funding 101: Funding Opportunities for Graduate Students”, “Scientific Journalism”, “Life as a Forensic Scientist”, “Planning Your Graduate Years and the Individual Development Plan”, “A Day in the Life of a Biotech Scientist”
Hosted New Student Acclimation Luncheons - “Everything You Need to Know About Research Rotations and Surviving C3MB”, “Surviving Grad School”, and “Choosing a Thesis Lab and Department”
The Community Outreach & Volunteering Committee participated in the following events - Homeless Stand Down 2010 through InterAct Cleveland, School Supplies Drive, and teaching a DNA Lab to underprivileged girls at an inner-city middle school in conjunction with the Department of Genetics
Social events included a party at Dive Bar, a pasta dinner social, and group outing to Wicked

In addition, doctoral students in the School of Medicine organize the annual Biomedical Graduate Student Symposium.
The Graduate Student Council (GSC) (http://gsc.case.edu/home/) is the governing body for all graduate students at CWRU. The aim is to enrich your experience at CWRU in every way possible. We connect students through social and professional events, provide funding and assistance for their initiatives, and work to ensure that they are treated as valued members of the campus community.

The Minority Graduate Student Organization promotes, engages and advances underrepresented minority graduate and postdoctoral trainees in the various fields of biomedical research within the Case Western Reserve University community, in the greater Cleveland area, and in the nation.

### Professional Development

The Graduate Education Office provides professional development opportunities for trainees including:

**Professional Development Seminar Series**

In the Graduate Education Office at the School of Medicine, we see the importance of developing our trainees not just in their academic studies but also in the development of trainees as professionals, strengthening their soft skills (leadership, teamwork, communication, emotional intelligence, etc.) that are vital in whatever career path they choose post-graduation. This seminar series is the combination of what was formerly known as Career Opportunities for Trainee Series (COTS) and The Professional Enrichment for Trainee Series (PETS).

This series incorporates a wide range intended to meet the needs of our School of Medicine master's and doctoral students as well as our postdocs. The content of this series provides the following opportunities aimed at our trainee's personal career growth and professional development:

- Introduce career paths that are available to biomedical graduates; Local, regional and national leaders are invited to speak on career trajectories, daily activities, additional training needed to enter this career path while investigating affordances and limitations to varied career paths. Sessions culminate in networking opportunities with speakers in an informal setting.
- Develop core competencies of leadership, entrepreneurship, communication skills, appreciative inquiry, emotional intelligence, teamwork and other key areas necessary for our trainee's professional development.
- Provide workshops and seminars for individuals that are planning to go to medical school, dental school or other allied health professionals, geared to better prepare our students and optimize their application experience yielding successful results.

**Pre-Professional Health Seminar Series**

The pre-professional health seminar series is geared for students who plan to go on to medical school, dental school or other allied health professions. Through workshops and seminars, we can help you make these applications less intimidating and you more prepared.

**Mental Wellness & Resilience Seminar Series**

The mental wellness and resilience seminar series is designed to provide trainees with the tools to develop coping mechanisms to manage and reduce stress.

**MGRD 425: Leadership and Professional Development Skills for Biomedical Sciences**

MGRD 425 Leadership and Professional Development Skills for Biomedical Sciences was designed to give graduate students in the biomedical and health sciences an opportunity to reflect on their professional skills and develop skills in the area of leadership, teamwork, critical thinking, creativity and problem solving. This course is typically offered each semester. It is a zero credit course that meets once a week.

### The Enhancing Research and Industry Career Horizons (EnRICH) Program

The CWRU School of Medicine EnRICH Program provides career guidance and support to PhD and Master’s students pursuing biomedical science degrees and simultaneously develops partnerships with organizations and mentors who recognize the skills of such students. A mentor and student spend time together for a paid or non-paid work or exposure experience that is beneficial to both the employer and student. The timeframe and duration of the experience are flexible where the mentor and student agree on the duration of the work experience and to an hourly and weekly work schedule. During the experience, students will clarify career goals as s/he; realizes the results of applied skills in a non-academic career; identifies ways to adapt skills for a variety of occupations and work environments, gains broader perspectives of careers that require his or her skills and talents, identifies ways to adapt skills for a variety of occupations and work environments, learns the business side of science and technology, and develops personal and interpersonal skills for relationship building to broaden professional networks. For more information, contact enrich@case.edu (entich@case.edu).

### The Expanding Teaching Experiences for Doctoral Students (ExTEnD) Program

The ExTEnD (https://case.edu/medicine/focus/admissions-programs/graduate-programs/career-professional-development/gain-teaching-experience/) program, open to all doctoral students at the CWRU School of Medicine, provides a way for graduate students to get formal experience in teaching at the university or college level by providing training and experiences in post-secondary education.

Students in this program complete program requirements by:

- Attending a one-semester seminar-style class taught by Educational Student Services to learn the basics of curricular design, development, and delivery

AND

- Completing two “significant” teaching experiences, such as:
  - Guest lecturing at least 5 class hours
  - Co-teaching a course at CWRU or another accredited university
  - Facilitating small group sessions for certain approved courses
  - Other teaching experiences as approved

Students completing program requirements will get a formal letter from the program director stating their completion of the program, as well as experiences, gained and feedback received as part of the program. For more information, email extend@case.edu (EXTEND@CASE.EDU).

### Biomedical Innovation and Entrepreneurship Club (BIEC)

Biomedical Innovation and Entrepreneurship club (BIEC) was created to provide graduate students, postdocs and research staff with the
opportunity to learn about entrepreneurship and commercialization in the biomedical sector. The main goal of this club is to break down the barrier between academia and industry, allowing young researchers to explore their interest in developing their own products or start their own company. Every third Wednesday of the month, local experts are invited to introduce the basics of commercialization such as intellectual property, regulatory, finances available at CWRU, and entrepreneurship opportunities here at CWRU to our trainees, and each meeting is wrapped up with a networking session. For more information, email cvmp@case.edu

CWRU Venture Mentor Program (CVMP)
The CWRU Venture Mentor Program (CVMP) provides team mentoring to CWRU and affiliate young faculty, students, and staff from a pool of local experts in a wide range of industries. Our process stems from the MIT Venture Mentor Service, a hugely successful program that has spawned over 100 similar programs across the U.S and around the world. Their processes are shown to provide a more likely chance that the venture will succeed, and that mentoring works best in a conflict-free, confidential, safe environment. For more information, email cvmp@case.edu

Biomedical Sciences Training Program (BSTP)
Phone: 216.368.3347
http://www.case.edu/med/BSTP/

George Dubyak, PhD (gxd3@case.edu), Director
Debbie Noureddine (dm2@case.edu), Coordinator

The Biomedical Sciences Training Program (BSTP) offers a common admission portal to most biomedical PhD degree programs at CWRU School of Medicine. The BSTP includes eleven doctoral programs in the School of Medicine with more than 200 faculty based in both basic science and clinical departments, giving BSTP students a tremendous range of research opportunities in many disciplines. It also provides a distinct advantage over traditional programs, which restrict choices of research area and faculty advisors.

Admissions
Students usually apply in the fall or winter and begin their studies the following summer. The application deadline is January 15th. Priority will be given to applications received by December 1. Applications will be considered by the Admissions Committee as soon as they are complete. In general a year of biology, organic chemistry and mathematics through calculus are required, and biochemistry and molecular biology are strongly recommended. We also seek students with strong backgrounds in physics or math who may be interested in our Structural Biology track (http://ssbb.tp.case.edu/) or Systems Biology and Bioinformatics (http://bioinformatics.case.edu/) programs. Depending on preparation, we may suggest additional biology coursework once graduate training begins. This background prepares most students for success in our programs.

Research Experience and Recommendations
Experience performing original research is essential. This might include an undergraduate honors thesis, summer research internships, or a technical position after graduation. Letters of recommendation from research mentors that describe creativity, handwork, and promise in science are very important.

Exams
The GRE general test is no longer required for admission through the BSTP. The Test of English as a Foreign Language (TOEFL) is required for international students unless they are from an English-speaking country or have a degree from a university where the instruction is primarily in English. Students may be eligible to apply for the transfer of some graduate credit from their previous institution. Please go here (http://gradstudies.case.edu/) for more information. Transfer credit must be requested prior to beginning coursework at CWRU.

The First Year
Coursework
Students take integrated courses in Cell and Molecular Biology (IBMS 453 Cell Biology I, IBMS 455 Molecular Biology I). They also complete a course in biostatistics (IBMS 450 Fundamental Biostatistics to Enhance Research Rigor & Reproducibility) and a literature based reading course (IBMS 456A Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section A ). These four courses, offered in the fall semester, emphasize the molecular approaches that form the basis of modern biology. We also seek students with strong quantitative training who may have majored in physics or math, and offer alternative courses for these students to acquire foundations in biology. Qualified students also may take more specialized elective courses. All students take IBMS 500 On Being a Professional Scientist: The Responsible Conduct of Research.

Research Rotations
The research rotations allow students to explore research areas and become familiar with faculty members and their laboratories. The main purpose of these rotations is to aid students in selecting a laboratory for their thesis work. Students are encouraged to begin their rotations in July. Doing so gives them the opportunity to complete rotations during the summer before classes begin at the end of August. Students must complete at least three rotations.

Choosing a Thesis Advisor
During the first year, students select an advisor for their dissertation research. Each student also joins the PhD program with which their advisor is affiliated. Once students choose a PhD program, the requirements of that program are followed to obtain the PhD. The emphasis of the PhD work is on research, culminating in the completion of an original, independent research thesis and publishing the results in the scientific literature. PhD programs also focus on educating students to work as professional scientists.

Participating Training Programs
- Biochemistry (http://bulletin.case.edu/schoolofmedicine/biochemistry/#phdtext)
- Cell Biology (http://bulletin.case.edu/schoolofmedicine/molecularbiologyandmicrobiology/#phdtext)
- Genetics and Genome Sciences (http://bulletin.case.edu/schoolofmedicine/genetics/#phdtext)
- Molecular Biology and Microbiology (http://bulletin.case.edu/schoolofmedicine/molecularbiologyandmicrobiology/#phdtext)
- Molecular Virology (http://bulletin.case.edu/schoolofmedicine/molecularbiologyandmicrobiology/#phdtext)
- Neurosciences (http://bulletin.case.edu/schoolofmedicine/neurosciences/#phdtext)
- Nutrition (http://bulletin.case.edu/schoolofmedicine/nutrition/#ph_d_text)
- Pathology (http://bulletin.case.edu/schoolofmedicine/pathology/)
Part of the first semester curriculum for first year graduate students along with IBMS 453. This course is designed to give students an intensive introduction to prokaryotic and eukaryotic molecular biology. Topics include protein structure and function, DNA and chromosome structure, DNA replication, RNA transcription and its regulation, RNA processing, and protein synthesis. Important methods in molecular biology are also presented. This course is suitable for graduate students entering most areas of basic biomedical research. Undergraduate courses in biochemistry, cell and molecular biology are excellent preparation for this course. Recommended preparation: Undergraduate biochemistry or molecular biology.

IBMS 455. Molecular Biology I. 3 Units.
Part of the first semester curriculum for first year graduate students along with IBMS 453. This course is designed to give students an intensive introduction to prokaryotic and eukaryotic molecular biology. Topics include protein structure and function, DNA and chromosome structure, DNA replication, RNA transcription and its regulation, RNA processing, and protein synthesis. Important methods in molecular biology are also presented. This course is suitable for graduate students entering most areas of basic biomedical research. Undergraduate courses in biochemistry, cell and molecular biology are excellent preparation for this course. Recommended preparation: Undergraduate biochemistry or molecular biology.

IBMS 456A. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section A. 1 Unit.
This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The IBMS 456A section will cover Nobel Prizes related to the areas of Genetics & Genome Science, Systems Biology & Bioinformatics, and RNA Biology. These include: 1) 2012 Prize, J. Gurdon and S. Yamanaka: Mechanisms of pluripotent stem cell development and reprogramming; 2) 2010 Prize, R. Edwards: Development of in vitro fertilization; 3) 2009 Prize, E. Blackburn, C. Greider, and J. Szostak: Mechanisms of chromosome protection by telomeres and telomerase; 4) 2009 Prize, Y. Ramakrishnan, T. Steitz, and A. Yonath: Structure/function analysis of ribosomes; 5) 2007 Prize, M. Capecchi, M. Evans, and O. Smithies: Discovery/development of transgenic and gene-deletion methods in mice; 6) 2006 Prize, A. Fire and C. Mello: Discovery/development of RNA interference-gene silencing methods; 7) 2006 Prize, R. Kornberg: Mechanisms of eukaryotic transcription; 8) 1995 Prize, E. Lewis, C. Nusslein-Volhard, and W. Wieschaus: Mechanisms of genetic control in early embryonic development.

IBMS 456B. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section B. 1 Unit.
This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The IBMS 456B section will cover Nobel Prizes related to the areas of Molecular Biology & Microbiology, Molecular Virology, Pathology-Immunology, and Cell Biology. These include: 1) 2016 Prize, Y. Ohsumi: Mechanisms of Autophagy; 2) 2015 Prize, W. Campbell, S. Omura, and Y. Tu: Therapies against roundworms & malaria; 3) 2011 Prize, B. Beutler, J. Hoffman, and R. Steinman: Mechanisms underlying innate immunity and adaptive immunity; 4) 2008 Prize, H. zur Hausen, F. Barre-Sinoussi, and L. Montagnier: Discovery of human immunodeficiency virus and oncogenic papilloma viruses; 5) 2008 Prize, O. Shimomura, M. Chalfie, and R. Tsien: Discovery/development of green fluorescent protein for biological applications; 6) 2005 Prize, B. Marshall and J. Warren: Discovery of Helicobacter pyloridis as pathogenic mechanism in peptic ulcers/gastritis; 7) 1999 Prize, G. Blobel: Mechanisms of protein sorting and subcellular trafficking; 8) 1996 Prize, P. Doherty and R. Zinkernagel: Mechanisms of cell-mediated immune defense.
IBMS 456C. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section C. 1 Unit.

This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The IBMS 456C section will cover Nobel Prizes related to the areas of Biochemistry, Nutrition, Pharmacology, and Pathology-Cancer. These include: 1) 2015 Prize, T. Lindahl, P. Modrich, and A. Sancar: Mechanisms of DNA Repair; 2) 2014 Prize, E. Betzig, S. Hell, W. Moerner: Development of super-resolution fluorescence microscopy; 3) 2012 Prize, R. Lefkowitz and B. Kobilka: Structure/function analysis of G protein-coupled receptors; 4) 2004 Prize, A. Ciechanover, A. Hershko, and I. Rose: Mechanisms of ubiquitin-mediated protein degradation; 5) 2003 Prize, P. Lauterbur and P. Mansfield: Development of magnetic resonance imaging (MRI) methods; 6) 2002 Prize, S. Brenner, H.R. Horvitz, and J. Sulston: Mechanisms for genetic regulation of organ development and programmed cell death; 7) 2002 Prize, J. Fenn, K. Tanaka, and K. Wuthrich: Development of mass spec and NMR methods for biological macromolecules; 8) 2001 Prize, L. Hartwell, T. Hunt, and P. Nurse: Mechanisms of cell cycle regulation.

IBMS 456D. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section D. 1 Unit.

This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The IBMS 456D section will cover Nobel Prizes related to the areas of Neuroscience, Physiology & Biophysics, and Pathology-Molecular Basis of Disease. These include: 1) 2014 Prize, J. O'Keefe, M-B. Moser, and E. Moser: Mechanisms of nerve cell spatial positioning in the brain; 2) 2013 Prize, J. Rothman, R. Scheckman, and T. Sudhof: Mechanisms of intracellular vesicle trafficking and biomolecule secretion; 3) 2004 Prize, R. Axel and L. Buck: Structure/function of odorant receptors and organization of olfactory system; 4) 2003 Prize: P. Agre and R. MacKinnon: Structure/function analysis of channel proteins in cell membranes; 5) 2000 Prize, A. Carlsson, P. Greengard, and E. Kandel: Mechanisms of signal transduction in the nervous system; 6) 1998 Prize, R. Furchgott, L. Ignarro, and F. Murad: Discovery/mechanisms of nitric oxide as signaling molecule in cardiovascular system; 7) 1997 Prize, S. Prusiner: Discovery/prions as new biological principle of infection in neurological disease; 8) 1997 Prize, P. Boyer, J. Walker, and J. Skou: Mechanisms of mitochondrial ATP synthesis and Na, K-ATPase pump function.

IBMS 500. On Being a Professional Scientist: The Responsible Conduct of Research. 1 Unit.

The goal of this course is to provide graduate students with an opportunity to think through their professional ethical commitments before they are tested, on the basis of the scientific community's accumulated experience with the issues. Students will be brought up to date on the current state of professional policy and federal regulation in this area, and, through case studies, will discuss practical strategies for preventing and resolving ethical problems in their own work. The course is designed to meet the requirements for "instruction about responsible conduct in research" for BSTP and MSTP students supported through NIH/ADAMHA institutional training grant programs at Case. Attendance is required.

IBMS 501. Responsible Conduct of Research for Advanced Trainees. 0 Unit.

The life of a professional scientist is complicated, and it is not always easy to know how to "do the right thing" with regard to their data, colleagues, and subjects. Responsible Conduct of Research (RCR) is an essential component of research knowledge. Active thought about the issues of RCR should occur throughout a scientist's career. Instruction in RCR should be appropriate to the career stage of the individuals receiving training. All doctoral students in the School of Medicine receive initial RCR training in their second semester and NIH requires another intense exposure if doctoral students are four years beyond their initial training. The goal of this course is to provide fifth year biomedical doctoral students with additional RCR training by exposing them to a variety of research ethics topics through lectures and small group discussions led by professional scientists and ethicists. Students will be brought up to date on the current state of professional policy and federal regulation regarding research (where these exist), and will discuss practical strategies for preventing and resolving ethical problems in their own work. This course is designed for predoctoral graduate students that are in their fifth year of graduate studies and MSTP students that are in their fourth year of their PhD phase of study. These sessions are also appropriate for postdoctoral trainees.

MGRD Courses

MGRD 310. Introduction to Clinical Inquiry (IQ). 3 Units.

This course is designed for pre-allied health students to introduce key overarching medical topics, including bioethics, public health and health disparities, as well as to integrate key MCAT topics from other courses into a clinically applicable context. Further, select human anatomy and physiology topics will be introduced. An important component of this course is the IQ process, which will reinforce scientific inquiry, self-reflection and constructive criticism. This course will have limited enrollment and is by permission only. Offered as MGRD 310 and MGRD 410.

MGRD 311. Introduction to Clinical Inquiry (IQ) II. 3 Units.

This course is the second semester in a 2 semester series designed for pre-professional health students to introduce key overarching medical topics, including bioethics, public health and health disparities, as well as to integrate key MCAT topics from other courses into a clinically applicable context. Further, select human anatomy and physiology topics will be introduced. An important component of this course is the IQ process, which will reinforce scientific inquiry, self-reflection and constructive feedback. Offered as MGRD 311 and MGRD 411.
Robotic Process Automation (RPA) is the fastest-growing software segment, growing at 63% in 2018. Many organizations are exploring or have implemented RPA. New college graduates will be a key driver in the future of automation. Students will be provided a comprehensive introduction to RPA centered on these fundamentals: overview of RPA, use of the technology, benefits and risks, and applications, process improvement and application to various work processes/industries. The course also includes guidelines on selecting the appropriate processes, workload and people implications, tools for automation, and strategies for successful implementations. It begins by introducing basic RPA concepts, the course then outlines how to apply these concepts to real working environment. UiPath is the primary software for students to practice and do group projects. The course is primarily intended for undergraduate students (in at least their junior year) who want to kick-start their career in this high-demand domain, have an interest in learning how to improve and want to use software to accelerate processes. Basic programming knowledge of any development language (C#, .Net, VB, Java, etc.) is beneficial but not required. Prereq: Undergraduate Junior or Senior standing.

MGRD 399. Independent Research in Biomedical Science. 1 - 3 Units.
This course is a graded independent research course offered in the School of Medicine at the undergraduate level. Students may use the School of Medicine EnRICH (Enhancing Research and Industry Career Horizons) program to find external research opportunities, may work in the laboratory of a School of Medicine faculty or may identify an appropriate mentored research opportunity independently. Students work with research mentor and course director to create their customized learning objectives. Grades are based on meeting objectives and completing reflections. In lieu of a final exam, students will give a short presentation on their experience and what they learned.

MGRD 401. PREP-aring for Success in a Biomedical PhD Program. 1 Unit.
This course is designed to prepare NIH Postbaccalaureate Research Education Program (PREP) Scholars for the rigors of a biomedical PhD program. This is a two-semester series (with MGRD 402 offered in the spring) that will help PREP Scholars navigate the biomedical PhD program application and admissions process, improve their application credentials, and prepare them for success in top biomedical PhD programs throughout the nation. Students continue receiving scientific research training, instruction and experience in reading the primary literature, developing oral and written communication skills, and participating in professional development activities. This semester, students will learn the skills necessary for professional interviews. They will also be exposed to grant writing including determining the proper available grant funding mechanisms, developing a testable hypothesis, generating compelling aims, and searching of relevant literature. They will prepare professional presentation of a journal article. They will also prepare and orally present their own research at our Annual PREP Research Day. Students will be graded on their quality of their work and the overall level of participation in class.

MGRD 402. PREP-aring for Success in a Biomedical PhD Program. 1 Unit.
This course is designed to prepare NIH Postbaccalaureate Research Education Program (PREP) Scholars for the rigors of a biomedical PhD program. This is a two-semester series (with MGRD 401 offered in the fall) that will help PREP Scholars navigate the biomedical PhD program application and admissions process, improve their application credentials, and prepare them for success in top biomedical PhD programs throughout the nation. Students continue receiving scientific research training, instruction and experience in reading the primary literature, developing oral and written communication skills, and participating in professional development activities. This semester, students, will learn the skills necessary for professional interviews. They will also be exposed to grant writing including determining the proper available grant funding mechanisms, developing a testable hypothesis, generating compelling aims, and searching of relevant literature. They will prepare professional presentation of a journal article. They will also prepare and orally present their own research at our Annual PREP Research Day. Students will be graded on their quality of their work and the overall level of participation in class.

MGRD 410. Introduction to Clinical Inquiry (IQ). 3 Units.
This course is designed for pre-allied health students to introduce key overarching medical topics, including bioethics, public health and health disparities, as well as to integrate key MCAT topics from other courses into a clinically applicable context. Further, select human anatomy and physiology topics will be introduced. An important component of this course is the IQ process, which will reinforce scientific inquiry, self-reflection and constructive criticism. This course will have limited enrollment and is by permission only. Offered as MGRD 310 and MGRD 410.

MGRD 411. Introduction to Clinical Inquiry (IQ) II. 3 Units.
This course is the second semester in a 2 semester series designed for pre-professional health students to introduce key overarching medical topics, including bioethics, public health and health disparities, as well as to integrate key MCAT topics from other courses into a clinically applicable context. Further, select human anatomy and physiology topics will be introduced. An important component of this course is the IQ process, which will reinforce scientific inquiry, self-reflection and constructive feedback. Offered as MGRD 311 and MGRD 411.

MGRD 425. Leadership and Professional Development Skills for Biomedical Sciences. 0 Unit.
This course is designed to give graduate students in the biomedical and health sciences an opportunity to reflect on their professional skills and develop skills in the area of leadership, teamwork, critical thinking, creativity and problem solving.
MGRD 525. Independent Study for PREP Scholars. 1 Unit.
Independent Study for PREP Scholars enables the Scholar to undertake study of advanced topics in biomedical research science that are not offered as standing courses at Case Western Reserve University. Generally, the Scholar(s) work closely with their primary research mentor to explore the background research literature and current results of the Scholar's research project. A guided program of study using research reviews, primary research papers, discussions, critiques, and grant-writing sessions will ultimately result in written research proposal that focuses on specific aims or goals of the project and the research strategy including the background, significance, innovation, and experimental approach. This is a one-credit graded course that requires approximately 15h of total contact time for the semester and 3-4 hours of outside work each week. The purpose of this course is to provide knowledge and experience in fellowship grant writing, with a focus on the F31 application. This course is for the students accepted and enrolled in the PREP program.

MGRD 610. Internship in Biomedical Sciences. 1 - 9 Units.
This course is an ungraded (pass/fail) internship. Students are expected to identify a potential internship that will enhance their career in a meaningful way. For example, a student interested in education might choose to work with the Great Lakes Science Center to develop and help deliver content for a medical-themed summer camp. Students interested in getting a job in industry may find a company in their field and intern with them. Research experiences within CWRU or affiliated hospitals MAY be appropriate only if the student wouldn't otherwise get those experiences in their program and it would significantly help their career. Therefore, all internships must be identified and approved by the course director and, if counting as an elective toward their degree, their program director, prior to enrolling. All students must identify an internship mentor at the location of their internship. The course director will check in with their mentor regularly to ensure an appropriate experience for student as well as the hosting institution. Credits depend on the scope of the internship. For each credit you are enrolled in, you will be expected to work at least 50 hours. So, in other words, if you register for 9 credits in one semester, you will be expected to work a total of at least 450 hours, or about 11-12 weeks full time. Thus, the number of credits registered should coincide with the agreed upon scope of the internship. In order to pass this course, students will be expected to keep, and submit weekly, a reflection log. In addition, students will be expected to present on their experiences, including what they did and what they learned, at an end of the semester, and their internship mentor, program director and other students in this course will be invited to attend this public presentation. Students who do not meet the criteria for hours worked, miss more than 2 of the weekly reflections or do not do an end of the semester presentation will receive a failing grade.

MGRD 701. Dissertation Ph.D.. 1 - 9 Units.
Research experience in a selected faculty research laboratory designed for international exchange students doing PhD dissertation research. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.