Case Western Reserve University School of Medicine Biochemistry MS Program
Student Handbook

The MS degree program is designed for students who wish to acquire expertise in biochemistry, with a view to working in the biotechnology industry or in research labs in academia or government. The MS degree is also excellent preparation for further education. The program consists of coursework and optional research in faculty laboratories. In addition, the Experimental Biotechnology track provides focused training in current techniques in biochemistry, cell biology and molecular biology.

Getting Started

Incoming students should contact the Graduate Program Director (GPD; Dr. Martin Snider) and the Graduate Education Coordinator (Ms. Cynthia Ernst) as soon as possible and meet with both to discuss the academic and administrative details of joining the program. International students must supply their home address to the federal Department of Homeland Security and may wish to check in with CWRU's *International Student Services* office (ISS; Tomlinson Hall 143; studentaffairs.case.edu/international; international@case.edu).

Students who plan to work in a research lab must complete lab safety training offered by CWRU's Environmental Health and Safety program before they can begin work. They should consult with the GPD and the Education Coordinator to determine what training they need. The times and locations of classes are listed on the Environmental Health and Safety web site (www.case.edu/ehs).

Students register for courses using the online Student Information System (SIS; sis.case.edu). Registration must be completed before the start of the semester. Late fees, which are the responsibility of the student, are assessed after classes start. The first two weeks of the semester are the Drop/Add period. Students can change their registration during this time freely and without penalty. The academic calendar (case.edu/registrar/dates-deadlines/academic-calendar) lists these dates for each semester.

Coursework

The MS degree requires 36 credit hours of coursework (12 graded). The program has two required didactic courses: BIOC 407: Introduction to Biochemistry: From Molecules To Medical Science and BIOC 408: Molecular Biology. The remainder of the curriculum is filled with advanced Biochemistry courses and offerings from other departments (e.g. Biology, Pathology, Neurosciences, Systems Biology). It also requires a comprehensive exam (EXAM 600; see below). Independent laboratory research may be carried out for credit (BIOC 601).

Full-time students complete the program in 4 semesters. This can be done in 21 months if the students do not enroll during the summer between their first and second years, or in 15 months if the students enroll for the summer as well. Part-time students usually complete the program within 3 years. Sample schedules are shown in the table.

Sample Schedules for the Biochemistry MS Program	
21 month program	**15 month program**
Year 1, Fall BIOC 407 Introduction to Biochemistry: From Molecules To Medical Science (4) BIOC elective (3) Elective (3)	**Year 1, Fall** BIOC 407 Introduction to Biochemistry: From Molecules To Medical Science (4) BIOC elective (3) Elective (3)
Year 1, Spring BIOC 408 Molecular Biology (4) BIOC elective (3) BIOC 601 Biochemical Research (2)	**Year 1, Spring** BIOC 408 Molecular Biology (4) BIOC elective (3) BIOC 601 Biochemical Research (3)
Year 2, Fall BIOC elective (3) Elective (3) BIOC 601 Biochemical Research (3)	**Year 1, Summer** BIOC 601 Biochemical Research (6)
Year 2, Spring BIOC elective (3) BIOC 601 Biochemical Research (4) EXAM 600 (1)	**Year 2, Fall** BIOC elective (3) Elective (3) BIOC 601 Biochemical Research (3) EXAM 600 (1)

The Experimental Biotechnology Track This track in the MS program prepares students for employment opportunities in biotech, as researchers in academia or the biotechnology industry. The track requires four courses (BIOC 500, 501, 502, and 511) in addition to BIOC 407 and 408. BIOC 500-502 form a sequence that introduces common techniques used in biochemistry labs and gives students hands-on experience and training in structured teaching labs. BIOC 511 covers issues of practice in academic and industrial labs. These courses may be taken in the first or second years. The table shows a suggested schedule. The completion of the track is recorded on the student's transcript.

YEAR 1			
Fall		**Spring**	
BIOC 407	Introduction to Biochemistry: From Molecules To Medical Science (4)	BIOC 408	Molecular Biology (4)
BIOC 500	Biotechnology Laboratory: Molecular Biology Basics (1)	BIOC 502 A, B, & C	Biotechnology Laboratory: Biochemical and Cellular Techniques for Biotechnology (2,2,1)
BIOC 501	Biochemical and Cellular Techniques for Biotechnology (3)		
BIOC 511	Practice and Professionalism in Biotechnology (1)		
YEAR 2			
Fall		**Spring**	
BIOC 412	Proteins and Enzymes (3)	BIOC 434	Structural Biology (3)
BIOC 601 (3)	Biochemical Research (3)	BIOC 601 or elective	Biochemical Research (2)
Elective	(3)	Elective	(3)
		EXAM 600	Master's Comprehensive Exam (1)

Areas of Emphasis: To guide students in selecting courses, the program has created several areas of emphasis. The areas listed below show courses that may be taken in addition to BIOC 407, BIOC 408 and EXAM 600. *These are suggestions only. Other courses may be substituted.*

Proteins and Enzymes - This is intended for students who wish to focus on the characteristics of proteins and nucleic acids. Courses can include:

- BIOC 412 Proteins and Enzymes
- BIOC 434, Structural Biology
- BIOC 475, Protein Biophysics
- BIOC 500 Biotechnology Laboratory: Molecular Biology Basics
- BIOC 501 Biochemical and Cellular Techniques for Biotechnology
- BIOC 502 Biotechnology Laboratory: Biochemical and Cellular Techniques for Biotechnology
- BIOC 511 Practice and Professionalism in Biotechnology
- BIOC 601, Research
- PHOL 456, Proteins and Nucleic Acid
  BIOL 415, Quantitative Biology Laboratory
- CHEM 429, Chemical Aspects of Living Systems

Biochemistry for Preprofessional Students - This is focused for students who are headed to medical school, dental school, nursing or graduate school (PhD). The diversity of coursework allows students to select classes that fit their educational path. Courses can include:

- ANAT 411, Gross Anatomy
- ANAT 412, Histology and Ultrastructure
- BIOC 420, Current Topics in Cancer
- NTRN 452, Nutritional Biochemistry
- BIOL 401, Biotechnology Laboratory
- BIOL 424, Introduction to Stem Cell Biology
- BIOL 426, Genetics
- GENE 500, Advanced Eukaryotic Genetics
- CLBY 416, Fundamental Immunology
- MBIO 434, Mechanisms of Drug Resistance
- PATH 475, Cell and Molecular Foundations of Pathology
- PHRM 409, Principals of Pharmacology
- PHOL 480, Physiology of Organ Systems
- STAT 312, Basis Statistics for Engineering and Science

Nutritional Biochemistry – The coursework in this area adds the components of nutrition to the basics of biochemistry. This focus is suitable for preprofessional students and for individuals with an interest in fitness, health, and public health.

- BIOL 480, Physiology of Organ Systems
- NTRN 433, Advanced Human Nutrition I
- NTRN 434, Advanced Human Nutrition II
- NTRN 455, Molecular Nutrition
- NTRN 530, Public Health Nutrition
- PHOL 481, Medical Physiology

Biochemistry and RNA Biology - This area of emphasis is ideal for students who wish to enter the world of RNA (a world where proteins are considered less important). These studies advance the students' appreciation of RNA structure and function and address methodology that may help to create RNA therapeutics.

- BIOC 454, Biochemistry and Biology of RNABIOC 500 Biotechnology Laboratory: Molecular Biology Basics
- BIOC 501 Biochemical and Cellular Techniques for Biotechnology
- BIOC 502 Biotechnology Laboratory: Biochemical and Cellular Techniques for Biotechnology
- PHOL 456, Proteins and Nucleic Acids
- BIOL 401, Biotechnology Laboratory
- BIOL 415, Quantitative Biology Laboratory.
- BIOC 599, RNA Structure and Function
- MBIO 445, Molecular Biology and Pathogenesis of RNA and DNA Viruses

Planned Program of Study

The Graduate School requires student to submit a Planned Program of Study (PPOS) through SIS by the end of their first year in the program. The PPOS contains all the courses that the student plans to take to complete the degree, including courses already taken and planned courses. The PPOS is a planning document; students can change their plans and register for other courses. After the PPOS is submitted, it is reviewed and approved by the advisor. Students can update their PPOS at any time. The revised plan must also go through the approval process. Instructions for submitting a PPOS are at case.edu/gradstudies/current-students/planned-program-study. *Graduate Studies puts a hold on the accounts of students who haven't submitted a PPOS in time, which prevents the student from registering until a PPOS is submitted.*

Dual Degrees

The MS program is part of several dual degree programs. These dual degrees are for students with broad interests that include biochemistry. They include:

JD/MS in Biochemistry. This program is designed for students interested in intellectual property law. The biochemistry portion of the degree provides students with the science background to practice intellectual property and patent law specializing in the biomedical sciences.

MA in Patent Practice/MS in Biochemistry. This program combines the unique one-year Patent Practice degree offered in the Law School, with the MS in Biochemistry. This program provides individuals with scientific knowledge allowing them to pursue careers in this area of patent practice.

MBA/MS in Biochemistry. This program is for students who are interested in the business aspects of the health and biomedical science fields (hospitals, pharmaceuticals, biotechnology, etc.).

See Appendix xx for details

MD/MS in Biomedical Investigation. This 5-year program is designed for medical students in the Cleveland Clinic Lerner College of Medicine, allowing them to earn an MS degree as they pursue the research that is required for this MD program in the CWRU SOM. It is also open to MD students in CWRU's University program. Students in this program may earn their MS degree in Biochemistry.

Grades

According to the Graduate School's regulations, MS students must have at least a B average (GPA ≥3.0) to graduate. Passing grades are A, B, C, or S. Research and seminar courses are graded

satisfactory/unsatisfactory (S/U). Students must retake a required course if they fail to get an acceptable grade.

The Comprehensive Exam

Biochemistry MS students write their comprehensive exam in their last semester in the program. This activity is done as EXAM 600 (1 credit). The student writes a research proposal in an area of their choosing. The goal is to pose a scientific question or hypothesis and propose experiments that will answer the question or test the hypothesis. The student then discusses this document in an oral examination with a committee of faculty members.

Students can use their independent research (BIOC 601) as the basis for their proposal. They can also base the proposal on another topic. Appendix 1 contains a detailed description of the comprehensive exam.

Program Seminars

The program has two weekly seminar series that are held in the fall and spring semesters. MS students are strongly encouraged to attend these seminars. They are an excellent opportunity for learning about research carried out in the Biochemistry program, at CWRU, and by scientists around the world. MS students can use these seminars to increase their understanding of research techniques and scientific advances; these are particularly valuable for students who wish to continue to PhD programs.

Monday PhD Student Seminars- PhD students give seminars on their thesis research to the program every year on Mondays at noon. This is an opportunity to learn about the work by student colleagues working in labs in the Biochemistry Program.

Thursday Biochemistry Research Seminars-The Biochemistry Department and the Center for RNA Science and Therapeutics sponsor a research seminar series on Thursdays at noon. Speakers from CWRU and outside the university present their research work. Groups of PhD students are invited to lunch with the speaker immediately following the seminar. MS students may request to be included in these lunches as well. These seminars are an excellent opportunity for students to meet visiting scientists, build their professional network, and expand their scientific knowledge.

Authorship and Credit for Work

Students must receive credit for their scientific work in publications. In a collaborative effort in which a student makes the major scientific contribution, the student's name should be the first author. Students should receive coauthorship for lesser contributions. Everyone who supervises the work of graduate students should work to ensure that students receive proper credit. If a student believes that proper assignment of credit has not been made, the questions should first be discussed among the collaborators. If agreement is not reached, the dispute should be submitted to the Graduate Education Committee.

Leaving the Program After Graduation

If a student has worked in a research lab, all research materials generated during the student's research are the property of the university by the rules of federal funding agencies. Because others will use these materials in future experiments these materials (cells, proteins, plasmids, etc.) must be catalogued and shared with others in the lab. After consultation with their advisor, the student may discard all materials that do not have further use. Similarly, all research records (notebooks, computer files, etc.) are the property of the university. They must be catalogued and left in the advisor's laboratory. Students may make copies of their research records. All university materials (ID card,

keys, etc.) should be returned following CWRU procedures.

PRACTICAL MATTERS

Portions of this section are based on the student handbook of the Physiology and Biophysics program.

International Students

International students often face additional challenges, especially if they are first-time visitors to the US. *International Student Services* (ISS; Tomlinson Hall 143; studentaffairs.case.edu/international; international@case.edu) provides information and support for incoming and current international students. ISS provides assistance to a population of more than 1,000 international students from over 80 countries. ISS helps students obtain visas and provides help with all immigration and visa issues. They can also help with a wide range of non-academic issues (housing, personal, financial, legal) that international students may encounter during their studies at CWRU. The office has walk-in hours and also responds promptly to email requests. It is especially important for students to use their expertise in all immigration- and visa-related matters.

Health Insurance

All students must have health insurance. Students can purchase coverage through the University's health plan. If a student has their own coverage (through a spouse or their family), they may waive purchasing coverage through the University (case.edu/studentlife/healthcounseling/medical-planwaiver-information/health-waiver-process). The University Health Services (UHS, 2145 Adelbert Road) provides health coverage to our students. CWRU also has an outside insurer for the Student/Dependent Medical Plan (students.case.edu/medicalplan/); details of plan coverage can be found online. UHS is staffed by health professionals with an interest in student health. These include physicians, nurse practitioners, psychologists, psychiatrists, social workers, and registered nurses.. More information may be obtained by visiting the UHS website (http://studentaffairs.case.edu/health) or by calling one of these numbers:

General Information:	368-2450
After Hours EMERGENCY SERVICES:	368-2450
General/Specialty Clinic Appointments:	368-4539
Women's Health Clinic Appointments:	368-2453
Counseling/Mental Health Clinic Appointments:	368-5872

Students should seek care through UHS before utilizing other providers because many preventive and regular well-person services can be obtained at no cost through UHS.

Dental Care

The CWRU School of Dental Medicine has dental clinics to provide training for pre-doctoral dental health professionals. Participants in the Student/Dependent Medical plans are eligible to receive free and discounted care through the School of Dental Medicine. Treatment is administered by pre-doctoral dental students under the close supervision of experienced dental health professionals. Services through the School of Dental Medicine are often significantly less expensive than going to a private practice dentist. More information is available at: students.case.edu/medicalplan/.

University Counseling Services (UCS)

Graduate school is a time of tremendous self-exploration and change. At times these changes are intentional and understandable; at other times they are unpredictable, chaotic and upsetting. Each

year over 1100 students seek out the staff of the University Counseling Services to help them gain perspective and to lay the groundwork for personal change. For many, the change can become a 'Turning Point' in their lives. UCS (case.edu/studentlife/healthcounseling) offers students help with their personal counseling and behavioral health needs, including individual, couples and group counseling, psychiatric medication management, stress management and recovery support. Its offices are staffed with psychologists, social workers and consulting psychiatrists: and group counseling, psychiatric medication management, stress management and recovery support. Most services are provided without cost.
220 Sears Library
Monday – Friday 8:30 – 4:30
Phone: 368-5872 (24/7)

Legal Services
The *Milton A. Kramer Law Clinic Center* at CWRU provides legal services to members of the community unable to afford legal counsel. Third-year law students act as the primary legal counsel in matters related to civil, community development, immigration, and health law. Go to:
law.case.edu/Academics/Experiential-Education/Milton-A-Kramer-Law-Clinic-Center

Housing
Most graduate students elect to rent housing in one of the many nearby neighborhoods. The University Housing office publishes the *Off-Campus Housing Bulletin* (my.case.edu/OCHB/Search.aspx, which contains apartment and house listings, roommate wanted advertisements, etc. that are located within a short distance from campus. The bulletin is updated each Friday at noon and can be viewed online by incoming graduate students. Many neighborhoods also have housing offices as well as guided tours of available rental properties. Contact local city governments for further information. Another alternative is the Steiner House Cooperative, which is a student-run organization offering housing for graduate students (steinerhouse.org).

Parking
The *Parking Services* (case.edu/parking) manages the University's parking program. All commuter students are eligible for parking permits upon enrollment. Students who need parking should contact *Access Services* (368-2273, parking@case.edu, lower level, Crawford Hall). Most graduate students park in surface lots or the Veale Garage (S-53) which are the most cost-effective lots nearest the School of Medicine.

Shuttle Services
There a many free shuttle bus routes that serve the campus, University Circle, and some neighborhoods in Cleveland Heights. Visitors may use UCI's public routes to reach various University Circle institutions. Service is provided approximately 18 hours per day Monday through Friday, with reduced service on weekends and holidays. Bus route schedules and maps are available at (case.edu/access-services/transportation/shuttles). There is also an app for mobile devices that shows the locations of buses in real time (case.edu/access-services/transportation/shuttles/shuttle-tracking).

Safe Ride Program
This program (case.edu/access-services/transportation/shuttles/safe-ride-program) provides safe

transportation around campus and the surrounding CWRU community between 7 pm and 3 am. The goal is to provide students with safe transportation late at night. You can request a pickup at saferide.case.edu or 216-368-3000.

Student Mail
Student mailboxes are located in the lunchroom (W429) . Please check your box regularly for mail. Be sure to use the 9 digit zip code for the Biochemistry Department (44106-4935). Using your CWRU address for private mail or packages is not allowed.

Building and Department Access
All Medical School buildings require ID card access. Biochemistry office personnel get card access for you using University ID. Activation usually takes 24 to 48 hrs. If you have forgotten your ID or your ID will not activate the card reader during evening hours, you can call the CWRU Police Department at 368-3333, and an officer will be dispatched to let you in. You will need to present a picture ID.

Campus Security
The University provides a variety of security and safety programs to help ensure a safe educational environment. These programs are directed by *the CWRU Police Department (*http://police.case.edu), located at the North Campus Security Office (11320 Juniper Rd). Security personnel patrol the campus and respond to emergencies, fire alarms, and routine security incidents. The Police Department can be reached at 368-3333 for emergencies and 368-4630 for non-emergencies.

CWRU has a safe campus, but everyone needs to contribute to their own safety. We strongly encourage everyone to:

- Be aware of your surroundings
- Use *Safe Ride* late at night
- Install the Rave Guardian app on your mobile device, which lets you communicate directly with CWRU police
- Sign up for safety alerts (text, email, voice). Go to getrave.com to sign up.

Computer Information and Tips for Biochemistry Students

E-mail–You must activate your CWRUnet e-mail account: The University has created an email account for you. You must be able to receive mail sent to this address! We will use this address to send you information about classes, rotations and program activities. Because this is the address that is published in the University directory, faculty members and other students will also use the address. You can either check mail directly in this account or you can have it forwarded to another address (see below).

Activating your account: You should have received an email from the School of Graduate studies that describes how to activate your account.

Your email address: Each email account can be addressed in several different ways. Your account name (e.g abc123) or firstname.lastname are accepted. You can also create other aliases (its-services.case.edu/mailalias/).

How to check your e-mail: All email accounts are run through Gmail. You can check your mail either using the web (webmail.case.edu) or using a separate mail client. If you already have another e-mail account that you wish to keep using, you can have your CWRU mail forwarded to that account. From webmail.case.edu, click the Settings link. You'll see a tab that lets you set up automatic forwarding of your mail. Just remember that you **must** receive mail sent to your CWRU account in a timely way.

Google Apps: CWRU provides applications from Google (G Suite) that include many useful functions. You can learn about them at case.edu/utech/help/knowledge-base/g-suite-education/g-suite-education-information.

Connecting your computer

Laptop computers can connect to the University network either through a wireless or ethernet connection. Go to https://its-services.case.edu/NetworkTools/IPDB/systemRegistrationForm.html to get your computer registered for a wired ethernet connection. For wireless connections, use CaseWireless and log in with your network ID and password. If you use a this connection, you are considered an on-campus user. For any other wireless connection (including CaseGuest), you are an off-campus user. You will need VPN to access some services, including the Software Center and electronic journals that require a subscription (see below)

The Help Desk
The University operates a Help Desk staffed with people who are both knowledgeable and helpful. You reach the help desk in several ways: Call 368-4357 (HELP) or go to help.case.edu. They can answer most questions about computers, software and networking. Everyone is entitled to one free walkin visit to a help center per year.

Electronic Journals
Electronic journals can be accessed from any CWRUnet computer through the Health Sciences Library. Go to case.edu/chslibrary/electronic-resources/electronic-journals on the Health Sciences Library web site for a complete listing. This page will take you to sites that will let you download articles as PDF files. This is the surest way to find online journals. Other links (e.g. the ones in Pubmed that take you to the publishers' sites) don't always work because they don't recognize the University's subscriptions.
The University purchases licenses for electronic journals. Access these on campus from a wired connection or using CaseWireless. Access from off campus requires VPN. Install the VPN client on your computer (vpnsetup.case.edu). To use the VPN client, open the software and log on with your Case ID and password using two factor authentication. Once this is done, your computer will behave as if it were part of the on-campus network.

PubMed
PubMed is available to you over the web in lots of different ways. One favorite is pubmed.com.

Electronic Resources for Learning and Research
Many other electronic resources are available through the University library. For more information go to: http://library.case.edu/ksl/index.html (Kelvin Smith Library)

http://www.cwru.edu/chsl/homepage.htm (Cleveland Health Sciences Library). The Electronic Books link at this site contains a list of sites with texts and protocols. In addition to the obvious ones, AccessMedicine and MDConsult have basic science textbooks.

Software

There's a lot of useful software for your personal computer that is either free or available at greatly reduced cost at softwarecenter.case.edu. To use the Software Center you must connect from a University ethernet connection, CaseWireless, or with a VPN connection.

Some software titles can only be downloaded once. If you start a download and then cancel it, this counts as a download, so be careful!

Appendices

Appendix 1 Exam 600 Comprehensive Exam Information

Appendix 2 Dual Degree Programs

EXAM 600- The qualifying examination for MS students in Biochemistry

In the Exam 600 project, MS in Biochemistry students write a research proposal in an area of their choosing. The goal is to pose a scientific question or hypothesis and propose experiments that will answer the question or test the hypothesis. The student then discusses this document in an oral examination with a committee of faculty members.

Choosing your topic–You can base your topic on work you have done as part of your research (BIOC 601). This is preferable because you are familiar with the topic, you have done background reading, and you experience with the relevant research techniques. You may also your proposal on another topic that interests you or that you have studied in a course. You should consult with other students, faculty members, and the MS Program Director as you select your topic and develop your ideas.

Approval of your topic–You should write a one-page summary of your proposal that includes: i) a short introduction, ii) a description of your research question or hypothesis, and iii) a description of the proposed experiments and how they will address your hypothesis. This will be due in the 5th week of the semester. The faculty will give you comments on your document and approve your topic, so you can prepare your final document. The MS Program Director will also select a committee of 3 faculty members who participate in oral exam.

Your Research Proposal–This proposal should be a 10- to 20-page document (Sections 1-5, double spaced). The document should have the following sections:

1. Abstract. (less than one page) A summary of your proposal, focusing on the question you will ask, the experiments you propose, and how they will advance our knowledge in this field.
2. Introduction– (2-3 pages) This section should summarize the state of knowledge in the field and introduce the research area you'll focus on in your experiments. This is similar to the introduction to a research article, but will be longer and more complete. The end of this section should contain a clear presentation of your research question or hypothesis.
3. Preliminary data – (2-3 pages of text) This section should present what is known, as a starting point for your proposed experiments. You may present your research data (from BIOC 601) or the figures from a recent research publication.
4. Proposed experiments – (10-12 pages) This section is the heart of the proposal. It should present the experiments that you would do over 2-3 years to address the questions and hypotheses you've proposed. You should have a clear explanation of what each experiment will accomplish and how it will help to test your hypotheses. You do not need to describe the details of standard methods (gels, blots, sequence, immunofluorescence microscopy, structural studies), but you should describe the details of any unusual methods. You should include a discussion of all the possible outcomes of your experiments (what will you do if you don't get the expected result) and what you'll do if your first line of experimentation doesn't work (the protein doesn't crystalize).
5. Discussion – (1-2 pages) This section should summarize your expected findings and explain how those findings will represent significant scientific progress. You may wish to combine this section with the previous one.
6. Bibliography–This section should include all the references you have cited in your proposal. Please use a reference style from a biochemistry journal. Do not create your own. This section can be as long as you wish.

The proposal should be turned in 10-15 days prior to the exam to allow the committee to review it.

The oral exam–The exam will take 60-90 minutes. To facilitate discussion, you should prepare a short (~20 minute) slide presentation showing highlights of the proposal. The faculty committee will ask questions and discuss the proposal with the student to explore its strengths and weaknesses. The focus of the exam is the student's proposal, but the committee may ask questions about elements of basic biochemistry related to the proposal.

Biochemistry MS Program
Dual Degree Programs

MD/MS Biomedical Investigation-Biochemistry Track

The joint MD/MS program combines the Biochemistry MS degree the MD. The program combines limited credit from the medical core curriculum, 3-6 Biochemistry courses, participation in a common seminar series, scientific integrity training, and a research project that reflects a full year of research (18 hours of BIOC 601 Biochemical Research) culminating in a written report and examination. Both degrees can be completed within 5 years. Students who wish to join the MD/MS program may apply to the program after arriving at the University any time prior to fall of their second year of medical school

The Biochemistry track is designed to provide students with knowledge of the latest advances in biochemistry and related fields. Courses offered by other departments may be included with the approval of the GPD.

Students in the Biochemistry track must complete:

IBIS 401	Integrated Biological Sciences I	3
IBIS 402	Integrated Biological Sciences II	3
BIOC 412 or BIOC 434	Proteins and Enzymes Structural Biology	3
Electives in Biochemistry	(graded)	6
BIOC 601	Biochemical Research	18
IBMS 500	On Being a Professional Scientist: The Responsible Conduct of Research	1
IBIS 600	Exam in Biomedical Investigation	0

Students may finish in 18 months if they devote a summer to research (6 credits of BIOC 601).

JD/MS in Biochemistry

This program allows students in the School of Law to earn an MS degree in Biochemistry with an additional year of study. This program is useful for students planning careers in patent law or in areas related to biotechnology or pharmaceutical research.

Students in the School of Law can apply to the Biochemistry program for admission to the JD/MS program. In the dual degree program, students complete 12 fewer hours of law school coursework than they would if they were in the JD program alone. The Department of Biochemistry accepts 9 hours of law school classwork in courses dealing with science issues, in place of 9 credits of other elective work. Thus, the student will take a total of 27 hours of Biochemistry coursework of which at least 12 hours must be letter graded.

Dual degree students are advised about matters related to the JD degree by the Associate Dean for Academic Affairs at the School of Law. In addition, dual degree students are granted priority registration for upper-level courses, ensuring that they will be able to adjust their schedules to take all the required classes. Dual degree students are advised concerning matters related to the MS in Biochemistry by the program's Graduate Advisor.

Biochemistry MS Program
Dual Degree Programs

JD/MS in Biochemistry Plan of Study (coursework oriented)

Because most students will apply for the JD/MS in Biochemistry Program after beginning Law School, the sample schedule below begins with Biochemistry coursework in the third year. However, Biochemistry coursework can be taken in any of the last three years in combination with Law courses. Schedules will be worked out with the Biochemistry GPD to suit the student's needs and interests.

First Year		**Units**
	Fall	**Spring**
Introduction to Biochemistry: From Molecules To Medical Science (**BIOC 407**)	4	
BIOC elective	3	
Molecular Biology (**BIOC 408**)		4
BIOC elective		3
Year Total:	7	7
Second Year		**Units**
	Fall	**Spring**
Proteins and Enzymes (**BIOC 412**)	3	
BIOC elective	3	
Structural Biology (**BIOC 434**)		3
BIOC elective		4
Master's Comprehensive Exam (**EXAM 600**)		1
Year Total:	6	8
Total Units in Sequence:		**28**

JD/MS in Biochemistry

Research Oriented

Students take 17 hours of graded coursework, including BIOC 407 and 408 and work on a research project in a faculty laboratory (10 hours of BIOC 601, Biochemical Research), 1 hour EXAM 600, Master's Comprehensive Exam. Students can take courses or do research during the summer. However, most students have chosen to use this time for legal internships.