

College of Medicine & Life Sciences

2020-21 Catalog: Graduate Programs

The College of Medicine & Life Sciences at the University of Toledo offers several graduate-level degree and certificate programs. PhD and MS degrees in biomedical sciences and academic certificates are offered in several basic science and clinical tracks.

Admission to Graduate Programs

Admission requirements for College of Graduate Studies are discussed in the general College of Graduate Studies section of the University of Toledo Catalog; other admission procedures are described under individual graduate programs. Admission to graduate study in the College of Medicine & Life Sciences is open to graduates of accredited colleges and universities meeting the minimum admission requirements of the College of Graduate Studies as well as specific admission requirements of the department and/or program. Previously admitted students wishing to transfer to a different program must apply for admission to the new program. Admission to one graduate program does not guarantee admission to another graduate program. Please refer to the degree or program descriptions for specific information.

Administration of Programs

All graduate programs in the College of Medicine & Life Sciences are administered jointly by the College of Medicine & Life Sciences and the College of Graduate Studies of the University of Toledo. Students may contact specific departments or programs, the college's graduate advisor, or the College of Graduate Studies for further information on programs or admission requirements. Student should be aware that course names/credit hours may be revised over the course of the program per the department or program requirements. Please consult with your department or program regarding course/credit hour changes.

Advising

Students must meet with their faculty advisor for the purpose of developing a Plan of Study. It is the student's responsibility to meet all requirements for the degree as specified by the graduate program, the department, the College of Graduate Studies and the University of Toledo. Students are encouraged to complete the Plan of Study no later than the first academic year and submit the completed, signed form to the College of Graduate Studies.

Academic Standards

In addition to the general academic standards outlined in the general section of the College of Graduate Studies Catalog, for the following programs, a **maximum number of credits of C** will be allowed on a candidate's Plan of Study as listed below:

- 10 credits PhD degree (biomedical sciences - all tracks)
- 8 credits MSBS research tracks (including CAB, MOME, MMIM, NND, and BIPG)
- 11 credits Physician Assistant Program (PA)
- 12 credits MSBS clinical track programs including MS Medical Sciences (unless stated otherwise)
- 3 credits Certificate programs

In addition, students in all graduate programs at UT must earn a cumulative GPA of 3.0 to graduate.

Graduate Degrees Offered

Doctor of Philosophy in Biomedical Science

Cancer Biology	(Department of Cancer Biology)
Molecular Medicine* (*previously Cardiovascular and Metabolic Disease)	(Department of Physiology & Pharmacology)
Medical Microbiology and Immunology** (**previously Infection, Immunity, and Transplantation)	(Department of Medical Microbiology & Immunology)
Neurosciences and Neurological Disorders	(Department of Neurosciences)

Doctor of Philosophy in Biomedical Engineering (see College of Engineering catalog)

Master of Science in Biomedical Sciences

Assistant in Pathology
Bioinformatics and Proteomics/Genomics
Biomarkers and Diagnostics (Professional Science Masters)
Molecular Medicine
Medical Microbiology and Immunology
Human Donation Sciences (Professional Science Masters)
Medical Physics
Medical Sciences
Oral Biology
Orthopedic Sciences
Physician Assistant Studies

Dual Degrees^{*,**}

Doctor of Medicine and Doctor of Philosophy in Biomedical Science*

Please go to this link for more information

<http://www.utoledo.edu/med/mdphd/pdf/2016%20UT%20MDPhD%20Handbook.pdf>

Doctor of Medicine and Master of Science in Biomedical Science*

Doctor of Medicine and Master of Public Health*

*Students must be accepted into the MD program first to be eligible for the dual degree (contact the College of Health Sciences for additional information about Master of Public Health requirements)

**Additional Dual Degrees available in MD/JD (contact Medical School Admissions) and MD/MBA (Refer to the College of Business and Innovation catalog for additional information).

Graduate Certificates

Certificate in Biomarkers and Bioinformatics
Certificate in Pathology for Post Second Year Medical Students

Biomedical Sciences: PhD and Masters Programs

Accreditation

Graduate programs are accredited either by discipline-specific accrediting agencies or by the Higher Learning Commission of the North Central Association.

General Admission Standards

To be admitted to the Ph.D. or Master of Science in Biomedical Sciences (MSBS) Program, applicants must hold an earned baccalaureate (or equivalent) from an accredited college or university and have a minimum overall GPA of 3.0 on a 4.0 scale. Typically, applicants will have an undergraduate major in Biology or a related discipline. In addition, Graduate Record Examination

(GRE) scores are required in most programs of study (see individual degree programs for specific requirements). Minimum scores at the 50th percentile or above for both Verbal and Quantitative scores and 4.0 (Analytical Writing Test) are recommended to be competitive for most degree programs. For international applicants, an appropriate test of English language proficiency is required. Scores from The Test of English as a Foreign Language (TOEFL) are accepted and a minimum iBT score of 80, or pBT score of 550 is required. Scores from The International English Language Testing Service (IELTS) are also accepted and a minimum score of 6.5 is required. A prior Masters degree is not required to enter the PhD program. At this time, all students accepted without provisions into the PhD in Biomedical Science Program, and maintaining good academic standing, will receive a full tuition scholarship and a research stipend funded in whole or in part by the College of Graduate Studies and funding from a student's advisor through a grant(s). There are also a limited number of tuition scholarships and stipends available for students in the Masters in Biomedical Science programs.

Master of Science Biomedical Sciences: Assistant in Pathology

Nicole Dominiak, MD Program Director

Admission Requirements

For complete up-to-date information and admission requirements go to <https://www.utoledo.edu/med/depts/path/admission.html>

1. Bachelor of science or health science from regionally accredited college or university with minimum cumulative and science 3.0 GPA (Exceptions can be made if the applicant has a terminal Ph.D., M.D., or M.B.B.C.H degree)
2. Complete on-line application form: https://apply.utoledo.edu/prod/bwskalogs_p_disloginnew
3. Official transcripts
4. \$45 application fee domestic students, \$75 fee for international students
5. 3 letters of recommendation
6. Passing TOEFL or IELTS (only international students)
7. One shadowing experience in autopsy and surgical pathology
8. Prerequisites Courses with minimum GPA of 3.0 on 4.0 scale:

The applicant should have successfully completed the following courses: general chemistry with lab, organic chemistry or biochemistry with lab, biology with lab, microbiology with lab, College level Mathematics and College level English Composition.

Core Courses

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
<u>Fall</u>		
ANAT5000	Anatomy for PA	5
PHSL5050	Human Physiology	3
PATH6060	Intro Surgical Pathology – Didactic	2
PATH6080	Intro Post Mortem Pathology (Hospital + Forensics) – Didactic	2
INDI8790	Basic and Advanced Light Microscopy.....	4
Total	.....	16
<u>Spring</u>		
PATH6060	Intro Surgical Pathology – Clinical	2
PATH7130	Path Case Studies	6
PATH6080	Intro Post Mortem Pathology (Hospital + Forensics) – Clinical	2
PATH6770	Embryology	1
Total		11
<u>Summer</u>		
PATH6890	Independent Study in Pathology (LIS, Lab management) (LIS, medical terminology, lab management)	4

PATH6060	Intro Surgical Pathology – Clinical	2
PATH6080	Intro Post Mortem Pathology (Hospital + Forensics) – Clinical	2
Total		8

Fall

PATH6780	Histology and Cell Physiology I	2
PATH7130	Path Case Studies	3
INDI6980	Scholarly Project	3
PATH6070	Intro Clinical Lab Medicine	2
Total		10

Spring

PATH6790	Histology and Cell Physiology II	2
PATH7130	Path Case Studies	3
INDI6980	Scholarly Project	3
PATH6040	Medical Ethics for Pathologist Assistant	1
Total		9

Minimum total credits for MSBS Assistant in Pathology is 54 credits

Student Learning Objectives

At the end of the program, the students will be able to:

Autopsy Service

- perform a complete autopsy including evisceration, dissection and examination of the various organs including brain
- describe grossly all organs from a given autopsy

Surgical Pathology

- perform gross examinations on surgical specimens
- cut and stain frozen sections
- compile related medical history to the surgical specimens
- evaluate image findings to the surgical specimens

Clinical Pathology

- interpret peripheral blood smears
- provide clinicopathologic correlations for chemistry, microbiology, immunology tests

Electives and Scholarly Activities

- analyze scientific articles
- prepare and present scientific papers at annual scientific day

Bioinformatics and Proteomics/Genomics

Robert Blumenthal, Ph.D., director

The Bioinformatics and Proteomics/Genomics (BPG) Programs are designed to provide training in the rapidly-developing interface between computer science and life sciences. Graduates with such training are in high demand, (in part due to the explosion in genome sequence analysis), whether the BPG studies are for an independent degree or for one of the several dual-degree programs. In addition, students in other programs may take BPG courses as electives.

Masters, Certificate and Dual Degree Programs

The program in Bioinformatics and Proteomics/Genomics, along with the Ohio Center of Excellence for Biomarker Research and

Individualized Medicine at the University of Toledo, offers a Certificate that can be earned either alone or in association with the degrees of Doctor of Philosophy (PhD) or Doctor of Medicine (MD). The Certificate program is designed to fit smoothly into the doctoral programs with minimal extra time required. BPG also offers a Master of Science in Biomedical Sciences (MSBS) degree. MSBS students follow a well-defined curriculum that includes core courses, journal club, seminars, independent research, and electives in their area of interest. Both Certificate and MSBS students are trained in the theory, methods and applications of bioinformatics, proteomics, genomics, and biomarker research.

Bioinformatics programs generally place more emphasis on either the computer science or the biomedical aspects of the field. The University of Toledo's program falls into the latter category. However, there are courses in PERL, Java, and SQL programming (for example), and the Program provides biomedical researchers with a solid introduction to the computational aspects, or computer science experts with a rigorous introduction to the biomedical aspects of bioinformatics.

Master of Science in Biomedical Sciences: Bioinformatics and Proteomics/Genomics

To be admitted to the Masters in Biomedical Sciences Program with Regular status, applicants must hold an earned baccalaureate (or equivalent) from an accredited college or university. Students with a GPA below 3.0, but at or above 2.5, may apply for provisional acceptance that would change to regular (non-probationary) status if their first term graduate coursework has a GPA of 3.0 or above. Typically, applicants will have an undergraduate major in Biology or a related discipline such as Biochemistry or Biophysics. Students with other majors are encouraged to apply; however, their coursework should include several semesters in biology. The GRE is not required for US students with GPA above 3.0, UT or Findlay students entering the bachelors-masters pipeline program, or students with a recent MCAT score of 25 or higher. The GRE is required for all other applicants. For international applicants, the Test of English as a Foreign Language (TOEFL) is also required. Scores must be 550 or higher for paper-administered version, 213 or higher for computer-administered version, and 80 or higher for internet-administered version. For all applicants, laboratory research or computer programming experience is favored, but not required.

*(CPRA = Current Problems & Research Approaches)
(BIPG = Bioinformatics & Proteomics/Genomics)

Fall Year 1

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
	Introduction to Biomedical Research	0
BMSP6340	*CPRA Genes & Genomes	2
BIPG5200	Statistical Methods in BPG	3
BIPG5100	Fundamentals in BPG	3
BMSP6390	**Mentored Research (2x4 wk lab rotations)	1
Total		9

**Students must register for a specific 8wk/2cr section of BMSP6390 Mentored Research. As a prerequisite, students must attend an introductory series of short research presentations "Introduction to Biomedical Research". These presentations do not require register, but are BIPG students are expected to attend for the first 3-4 weeks of the Fall semester.

Spring Year 1

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BIPG6100	Bioinformatic Computation	3
BIPG6400	Applications of BPG	3
	OR	
BRIM6200	Biomarker Discovery, Validation and Implementation	3
BMSP6350	Cell Biology & Signaling	3
Total		9

*** Students must pass Qualifying Exam before registering for BIPG 6990 Thesis research. In this and other terms, with permission of advisory committee, student may take Scholarly Project in BPG (BIPG5900) in place of Thesis in Bioinformatics

Summer Year 1

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BIPG5400	Bioinformatics Databases	1
BIPG5500	Microarray Analysis	1
BIPG6900	Thesis in Bioinformatics	3
INDI6020	“On Being a Scientist”	1
Total		6

Fall Year 2

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
Elective 2	(see approved list)	3
BIPG5300	*Current Topics in BPG.....	1
BIPG6990	Thesis in Bioinformatics	5
Total	.....	9

* Journal paper review and presentation

Spring Year 2

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
Elective 2	(see approved list)	3
BIPG6990	Thesis in Bioinformatics	6
Total	9

Summer Year 2 (if required)

BIPG6990	Thesis in Bioinformatics	6
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The minimum number of credits required for MSBS is 46.5, with a minimum of 20.5 credits of didactic coursework (letter grade), and a minimum of 10 credits of thesis research. The rest of the credits are approved electives and research in the BIPG track.

Master of Science in Biomedical Sciences: Professional Science Masters in Biomarkers and Diagnostics

The Professional Science Master in Biomarkers and Diagnostics (MSBS-PBD) is designed to be a terminal degree with the graduate having strong prospects for immediate employment in industry. The MSBS-PBD degree is a “job ready” degree. This is achieved by a three-pronged approach:

- To prepare master’s students with a strong foundation in the fundamentals of biomarker discovery and development through focused course work.
- To complement their science education through course work in management, orienting them to realities of the business aspects of the pharmaceutical/ diagnostics industry.
- To place them as interns in a pharmaceutical- or diagnostic-oriented company for four months to enhance their practical training and employability.

The MSBS-PSMBD program is targeted to students completing a bachelor in computer science, chemistry or a biological or pharmaceutical science.

*(CPRA = Current Problems & Research Approaches)

Fall

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BIPG5200	Statistical Methods in BPG	3
BMSP6340	CPRA in Genes and Genomes.....	2
BIPG5100	Fundamentals of Bioinformatics	3

INDI6020	“On Being a Scientist”	1
Either:		
MGMT6150	Leading and Developing Yourself.....	3
Or		
MGMT6160	Leading with Power and Influence.....	3
Either:		
HURM6720	Adv Negotiations/Conflict Resol.	3
Or		
HURM6700	Human Resources Management	3

Spring

Course	Course Name	Credit Hours
BIPG6100	Bioinformatic Computations	3
BMSP6350	Cell Biology & Signaling.....	3
BRIM6200	Biomarker Discovery, Validation, and Implementation.....	3
HURM6730	Performance Management.....	3

Summer

Course	Course Name	Credit Hours
BIDI5100	Biomarkers and Diagnostics Internship	6-8
BIDI5200	Readings in Biomarkers/Diagnostics (Online).....	1
BIPG6890	Independent Study in BPG.....	2

The minimum number of credit hours for completion of the MSBS, PSM in Biomarkers and Diagnostics degree is 36.5 credits.

CERTIFICATE IN BIOINFORMATICS AND BIOMARKERS

The Biomarkers and Bioinformatics (BRIM) Certificate Program introduces students to the rapidly growing fields of bioinformatics, proteomics and genomics, and provides a core knowledge of analytical approaches used in these fields. It is particularly valuable for PhD students whose research would be strengthened by expertise in bioinformatics.

Students enrolled in the BRIM Certificate Program have the choice of taking three of the five courses covering the following subject areas:

1. Introduction to the scope of bioinformatics, proteomics and genomics: “Fundamentals of BPG”
2. Training in statistical methods used in biomarker research and bioinformatics: “Statistical Methods in Bioinformatics”
3. Handling and manipulation of databases and introduction to computer programming skills needed to analyze large quantities of nucleic acid and protein sequence data: “Introduction to Bioinformatic Computation”
4. “Applications of BPG” in which faculty members using these methods will discuss and demonstrate how these techniques are utilized to solve research problems
5. “Biomarker Discovery, Validation and Implementation” in which faculty will provide an overview of biomedical discovery and validation techniques followed by application in selected aspects of individualized medicine.

Upon completion of the Program, students will be prepared to utilize biomarker research and bioinformatics techniques, and be able to interact with specialists in a range of biomedical sub-disciplines.

Curriculum

The curriculum consists of three, 3-credit courses, for a total of 9 credits (listed below) that can be taken over 1-4 years: (BPG – Bioinformatics and Proteomics/Genomics). The following shows the available courses. The choice of which three courses to take should be made in consultation with the Program Director.

(BIPG – Bioinformatics and Proteomics/Genomics)

Fall Year 1

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BIPG5100/7100	Fundamentals of BPG	3
BIPG5200/7200	Statistical Methods in BPG	3

Spring Year 1

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BIPG6100/8100	Bioinformatic Computation	3
BIPG6400/8400	Applications of Bioinformatics (odd yrs)	3
OR		
BRIM6200/8200	Biomarker Discovery, Validation and Implementation (even yrs)	3

*BMSP6340 Current Problems & Research Approaches in Genes and Genomes, or equivalent course approved by the BRIM/BPG Program, is required for admission into the Bioinformatics & Biomarkers Certificate Program.

NOTE: The University of Toledo PhD or MSBS students may also take individual BPG or BRIM courses as electives, with permission of the instructor. To receive a Certificate in Biomarkers and Bioinformatics, however, an online application to the program must be submitted and accepted. All applications will be reviewed by the BRIM/BPG Program Admissions Committee. The online application must be filed ONLY for those seeking a certificate and is not required for those taking these courses as electives.

Applying to the BRIM/BPG Certificate Program:

UT students who are currently in a PhD program:

1. Complete the Request to Add a Graduate Certificate form at the following link, and return to the Graduate School for processing: https://www.utoledo.edu/graduate/files/Request_to_add_a_grad_certific.pdf
2. Submit a letter of support from major advisor.

Applicants who are NOT UT graduate students:

1. Complete online application. <https://apply.utoledo.edu>
2. Submit Official transcripts
3. Earned bachelors or graduate degree and GRE score
4. Statement of Purpose
5. Two letters of recommendation are required, three letters are optional. In the event that a student decides to pursue the BIPG MSBS degree, it will save time to have the letters of recommendation already on file.

MD/MSBS Bioinformatics Degree

This is designed for students already in our MD program, who want preparation for clinical research in gene therapy, biomarker discovery, or other aspects of cutting-edge medicine. It involves one year of coursework and research between the 2nd and 3rd years of the standard medical curriculum.

BS/MSBS "Pipeline" Program

This is an integrated program that can be completed in as little as 5.5 years, yielding both a University of Toledo bachelors of sciences in Biological Sciences and an MSBS in Bioinformatics. This reduced time is made possible in part by 9 University of Toledo credit hours being allowed to count towards both degrees. Students (University of Toledo biology majors) typically apply at the end of their sophomore year. For more information, go to the Pipeline Program website:

<http://www.utoledo.edu/med/depts/bioinfo/pages/pipeline%20ut.html>

Doctor of Philosophy in Biomedical Sciences: Cancer Biology Track

Department of Cancer Biology

JianTing Zhang, Ph.D., chair

Kandace Williams, Ph.D., co-track director

Dayanidhi Raman, Ph.D., co-track director

The Cancer Biology track within the Biomedical Science Program at the University of Toledo fosters young scientists to become cutting-edge researchers who understand the molecular and genetic basis of cancer and the knowledge to develop improved therapies for human cancer. Students in the Cancer Biology track develop scientific thinking and laboratory skills to approach cancer research questions in ways that will best lead to success. Graduates of the Cancer Biology program move on to become successful scientists and leaders in academic, government, and industrial settings. CAB students may pursue the Doctor of Philosophy (PhD) degree or, after acceptance into the medical school, a combined MD/PhD degree. The Masters' degree in Cancer Biology is not currently offered.

The CAB program faculty research interests and areas of expertise are: 1) Control of tumor cell growth and death, 2) Signal transduction, 3) Mechanisms of cancer cell motility and chemotaxis, 4) Invasion and metastasis, 5) Molecular genetics of cancer risk, 6) Influence of tumor microenvironment on cancer progression and metastasis, 7) Protein trafficking, 8) Epigenetic regulation of oncogenes and tumor suppressor genes. 9) Chromatin remodeling and mechanisms of DNA repair, 10) Nitric oxide signaling alterations in cancer cells and 11) Adipogenesis and pre-adipocyte/adipocyte functions; Role of adipokines in cancer.

Cancer Biology PhD students enroll in a first-year core curriculum that is designed to provide a foundation of knowledge for cutting edge research. The first-year curriculum provides students with a comprehensive overview of molecular and cellular biology, systems pathophysiology, modern research methodology, and statistical analysis. In addition, students complete laboratory rotations during the first two semesters to identify a Cancer Biology major advisor and laboratory for their dissertation research project. PhD students complete three rotations and then may join a Cancer Biology laboratory in the spring semester of their first year. Doctoral students in good academic standing may be supported financially by a tuition scholarship and stipend during their academic training. This financial assistance does not require the student to be a Teaching Assistant for undergraduates, thus enabling the student to more fully concentrate on his/her graduate program.

PhD Program Students: Year 1***

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
	Introduction to Biomedical Research	0
Current Problems and Research Approaches (CPRA) in;		
BMSP6330	CPRA in Proteins	2
BMSP6340	CPRA in Genes and Genomes	2
BMSP6360	CPRA in Cell Membranes	2
BMSP6380	Methods in Biomedical Sciences	2
BMSP6390	Mentored Research (two 5 week lab rotations)	1
Total		9

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6470	Systems Pathophysiology	4
BMSP6350	CPRA in Cell Biology and Signaling	3
BMSP6390	Mentored Research (one-two 5 week lab rotation)	1
CABP6560	Readings in Cancer Biology	1
Total		9

Summer Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP7320	Statistical Methods I*	3
CABP6730	Research in CABP or	0-3
CABP6890	Independent Study in Cancer Biology	
	Or other Electives (optional)	0-3
INDI6020	"On Being a Scientist"	1

Total 6

PhD Program Students: Year 2***

PhD Qualifying Examination - successful completion required by end of Fall semester of Year 2

Fall Semester (* = required) (** = only if Qualifying Exam has been passed)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP8270	Advanced Cancer Biology* (or take in third year)	0-3
BIPG7100	Fundamentals of BPG*	3
CABP9990	Dissertation Research** or	0-6
CABP6730	Research in CABP*	0-6
CABP8890	Independent Study in Cancer Biology Or other Electives (optional)	0-6
Total		9

Spring Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP8560	Readings in Cancer Biology*	1
CABP9990	Dissertation Research*	0-8
CABP8890	Independent Study in Cancer Biology Or other Electives (optional)	0-8
Total		9

Summer Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP9990	Dissertation Research*	1-6
CABP8890	Independent Study in Cancer Biology Or other Electives (optional)	0-6
Total		6

PhD Program Students: Year 3***

Fall Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP9990	Dissertation Research*	3-9
CABP8270	Advanced Cancer Biology* (if not taken in second year)	0-3
CABP8890	Independent Study in Cancer Biology Or other Electives (optional)	0-6
Total		9

Spring Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP9990	Dissertation Research*	8
CABP8560	Readings in Cancer Biology*	1
CABP8890	Independent Study in Cancer Biology Or other Electives (optional)	0-6
Total		9

Summer Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP9990	Dissertation Research*	6

PhD Program Students: Year 4***

Fall, Spring and Summer Semesters

Dissertation Research (CABP9990) Total of 9 credits Fall and Spring; 6 credits Summer

PhD Program Students: Year 5 and beyond*****Fall, Spring and Summer Terms**

Dissertation Research (CABP9990) Total 1 credit all semesters

***All CAB students are expected to give a CAB student seminar every year, except when the student's graduate advisory committee approves that s/he may begin writing their dissertation, that student may be exempt from giving a seminar but is still required to attend all CAB seminars during this time. CAB students are also required to present posters in the annual COMLS Graduate Student Research Forums and oral presentations in the annual Larry Gentry Research Symposia beginning in their second year.

The PhD Qualifying Exam is taken in the Fall semester of the second year. Prior to completing the exam, students should carry out their dissertation research under the course Research in CABP (6730) or in some cases, Independent Study in CABP (6890). After passing the Qualifying Exam, students conduct their research under the course Dissertation Research (CABP9990).

The minimum number of credits required for PhD is 90, with a minimum of 24 credits of didactic coursework (letter grade), and a minimum of 30 credits of dissertation research. The remaining credits are approved electives and research in the Cancer Biology track.

***Master of Science in Biomedical Sciences: Cancer Biology Track**

The Cancer Biology (CAB) track participates in the Masters in Biomedical Sciences training program. MSBS students are expected to complete a 1st year core curriculum similar to that of doctoral students, but CAB MSBS students join a laboratory after two rotations and elective courses are not required during the 2nd year. The primary goal of the MSBS program in CAB is to train students in the basic techniques required to perform molecular and cellular research on cancer topics and/or teaching. MSBS students are required to obtain a minimum of 40 credit hours total, with a minimum of 20 credit hours in didactic courses, and a minimum of 10 credit hours of thesis research for the MSBS degree. The rest of the credits are approved electives and research in the Cancer Biology track. MSBS students also are required to successfully pass a qualifying exam by the end of summer of their 1st year and to write and defend a research thesis before the degree will be conferred. MSBS students typically complete the degree requirements in 2-3 years.

Masters Program Students: Year 1

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
	Introduction to Biomedical Research	0
	Current Problems and Research Approaches (CPRA) in;	
BMSP6330	CPRA in Proteins	2
BMSP6340	CPRA in Genes and Genomes	2
BMSP6360	CPRA in Cell Membranes	2
BMSP6380	Methods in Biomedical Sciences	2
BMSP6390	Mentored Research (two 5 week lab rotations)	1
Total		9

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6470	Systems Pathophysiology	4
BMSP6350	CPRA in Cell Biology and Signaling	3
BMSP6390	Mentored Research (one-two 5 week lab rotation)	1
CABP6560	Readings in Cancer Biology	1
Total		9

Summer Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP5320	Statistical Methods I*	3
BIPG5110	Practical Bioinformatics*	1
INDI6020	"On Being a Scientist"	1
CABP6730	Research in CABP or	0-2
CABP6890	Independent Study in Cancer Biology Or other Electives (optional)	0-2
Total		6

Qualifying Examination must be successfully completed by end of summer semester, which consists of 20 questions taken from a '100 question cancer biology bank' that was given to you at the start of your first year. Prior to completing the exam, students should carry out their thesis research under the course Research in CABP (6730). After passing the Qualifying Exam, students conduct their research under the course Thesis Research (CABP6990).

Masters Program Students: Year 2

Fall Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP6270	Advanced Cancer Biology* (or take this course in third year)	0-3
CABP6990	Thesis Research*	1-9
	Electives	0-9
Total		9

Spring Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP6560	Readings in Cancer Biology*	1
CABP6990	Thesis Research*	0-8
	Electives	0-8
Total		9

Summer Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP6990	Thesis Research*	1-6
	Electives	0-6
Total		6

Masters Program Students: Year 3 (if necessary)

Fall Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
CABP6270	Advanced Cancer Biology * (if not taken in second year)	0-3
CABP6990	Thesis Research*	1-9
	Electives	0-9
Total		9

Spring Semester (* = required)

CABP6990	Thesis Research*	1-9
	Electives	0-9
Total		9

Summer Semester (* = required)

All Masters students are also required to present posters in the annual COMLS Graduate Student Research Forum and oral presentations in the annual Larry Gentry Research Symposia beginning in their second year.

Advanced Courses in the Cancer Biology Track

Advanced Cancer Biology

A comprehensive examination of the cellular and molecular foundation of cancer. Topics to be covered include: neoplasia; epidemiology and etiology; the role of causative agents such as chemicals, radiation, and viruses; cell proliferation, injury, and death; oncogenes; tumor suppressor genes; cancer therapies, and overviews of several major types of cancer.

Readings in Cancer Biology

A readings and discussion course that will examine classic and current research publications from within the broad realm of cancer biology.

Independent Study in Cancer Biology

In-depth study of research areas chosen by individual faculty. Examples of such topics may be: drug therapy and resistance, hormonal carcinogenesis, and epigenetic mechanisms of carcinogenesis.

Doctor of Philosophy in Biomedical Sciences: Medical Microbiology and Immunology Track

Department of Medical Microbiology and Immunology

Z. Kevin Pan, Ph.D., Chair

Z. Kevin Pan, Ph.D., Co-Track Director

Jason Huntley, Ph.D., Co-Track Director

The Medical Microbiology and Immunology (MMIM) (formerly Infection, Immunity and Transplantation) training program at the University of Toledo College of Medicine and Life Sciences on the Health Science Campus offers PhD, MD/PhD, and MSBS degrees through the Biomedical Science interdisciplinary degree program. The primary goal of the doctoral program in Medical Microbiology and Immunology is to train students for independent careers in bacteriology, virology, and immunology research and/or teaching.

MMIM PhD students enroll in a 1st year core curriculum that provides a comprehensive overview of biochemistry/protein biology, molecular and cellular biology, molecular basis of diseases, research methodology, ethics, and statistical analyses. PhD students complete three laboratory rotations during their 1st year and join a MMIM laboratory during the spring semester of their 1st year. In the 2nd year and beyond, MMIM PhD students take advanced and elective courses, including advanced immunology, advanced microbiology, current topics in MMIM (journal club and departmental seminar series), and dissertation research. Other training activities include formal research presentations at annual Medical Microbiology and Immunology Departmental retreats, Council for Biomedical Graduate Student research forums, and presentations at regional, national, and international conferences. All PhD students in good academic standing (GPA > 3.0) may be supported by a tuition scholarship and stipend during their academic training. This financial assistance does not require the student to be a Teaching Assistant for undergraduates, thus enabling the student to concentrate on his/her graduate research. Teaching experiences can be arranged if a student desires this training as well. All PhD students are required to complete a written dissertation and defend his/her research project at a final oral defense before the degree will be conferred.

MMIM students are strongly encouraged to join laboratories of MMIM primary faculty. Other faculty in the College of Medicine and Life Sciences may have joint appointments in MMIM or may serve on graduate advisory committees. After joining a laboratory, a graduate advisory committee is jointly chosen by the student and advisor to promote academic progress toward completion of the PhD degree. The MMIM Department occupies recently-renovated space and maintains state-of-the-art equipment to answer complex microbiology and immunology questions, including studies on host-pathogen interactions and immune-mediated diseases.

Year 1: PhD Students

(Note: "Current Problems and Research Approaches" abbreviated as 'CPRA' below)

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
n/a	Introduction to Biomedical Research	0
BMSP6330	CPRA in Proteins	2
BMSP6340	CPRA in Genes and Genomes	2
BMSP6360	CPRA in Cell Membranes	2
BMSP6380	Methods in Biomedical Sciences	2
BMSP6390	Mentored Research (two 5-week lab rotations)	1
<i>Fall Total</i>	.....	9

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6470	Systems Pathophysiology	4
BMSP6350	CPRA in Cell Biology and Signaling	3
BMSP6390	Mentored Research (one or two 5-week lab rotation)	1
MMIM6030	Current Topics in MMIM	1
<i>Spring Total</i>	.....	9

All students must pass MMIM '100 Question Exam' by May 30th of their 1st year

Summer Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP7320	Statistical Methods I	3
INDI6020	"On Being a Scientist"	1
MMIM6890	Research in MMI (Pre-Qualifying Exam)	3
<i>Summer Total</i>	.....	6

Year 2: PhD Students

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM8020	Advanced Immunology	1
MMIM8030	Current Topics in MMIM	1
MMIM6890	Research in MMI (Pre-Qualifying Exam)	7
<i>Fall Total</i>	.....	9

All students must pass Qualifying Exam by the end of fall semester (December) of their 2nd year

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM8040	Advanced Microbiology	1
MMIM8030	Current Topics in MMIM	1
MMIM9990	Dissertation Research in MMI	7
<i>Spring Total</i>	.....	9

Summer Semester (required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM9990	Dissertation Research in MMI	6
<i>Summer Total</i>	.....	6

Year 3 and 4: PhD Students

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM8030	Current Topics in MMIM	1
MMIM9990	Dissertation Research in MMI	8
<i>Fall Total</i>	.....	9

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM9990	Dissertation Research in MMI	8
MMIM8030	Current Topics in MMIM	1
<i>Spring Total</i>	.....	9

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM9990	Dissertation Research in MMI	6
<i>Summer Total</i>	.....	6

Year 5 and beyond: PhD Students

Fall and Spring Semesters

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM8030	Current Topics in MMIM	1 credit each in fall and spring

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM9990	Dissertation Research in MMI	1

Notes about MMIM PhD Program:

All PhD students must pass their Qualifying Exam by the end of the Fall semester (December) of the 2nd year. Before passing the Qualifying Exam, Ph.D. students should conduct research by registering for 'Research in MMI' (Satisfactory/Unsatisfactory; MMIM6890). After passing the Qualifying Exam, Ph.D. students should conduct their research by registering for Dissertation Research in MMI (MMIM9990).

The minimum number of credits required to obtain a Ph.D. is 90, with a minimum of 25 credits of didactic coursework (letter grade), and a minimum of 30 credits of dissertation research. The remainder of the credits are approved electives and research in the Medical Microbiology and Immunology track.

All Ph.D. students are required to register for Current Topics in MMIM (MMIM8030) during all fall and spring semesters while they are enrolled as a student. When a student's graduate advisory committee approves that he/she may begin writing their dissertation, that student then may be exempt from registering for Current Topics in MMIM.

Master of Science in Biomedical Sciences: Medical Microbiology and Immunology Track

The Medical Microbiology and Immunology (MMIM) (formerly Infection, Immunity and Transplantation) track participates in the Masters in Biomedical Sciences training program. MSBS students are expected to complete a 1st year core curriculum similar to that of doctoral students, but MMIM MSBS students join a laboratory after one or two rotations and fewer elective courses are required during the 2nd year. The primary goal of the MSBS program in Medical Microbiology and Immunology is to train students in the

basic techniques required to perform bacteriology, virology, and immunology research and/or teaching. MSBS students are required to obtain a minimum of 40 credit hours including 21 credit hours of didactic credits a minimum of 10 credit hours of thesis research for the MSBS degree. MSBS students also are required to successfully pass a qualifying exam by the end of summer of their 1st year and to write and defend a research thesis before the degree will be conferred. MSBS students typically complete the degree requirements in 2-3 years.

Year 1: Masters Students:

(Note: “Current Problems and Research Approaches” abbreviated as ‘CPRA’ below)

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
n/a	Introduction to Biomedical Research	0
BMSP6330	CPRA in Proteins	2
BMSP6340	CPRA in Genes and Genomes	2
BMSP6360	CPRA in Cell Membranes	2
BMSP6380	Methods in Biomedical Sciences	2
BMSP6390	Mentored Research (two 5-week lab rotations)	1
<i>Fall Total</i>	.....	9

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6470	Systems Pathophysiology	4
BMSP6350	CPRA in Cell Biology and Signaling	3
MMIM6890	Research in MMI	1
MMIM6030	Current Topics in MMIM	1
<i>Spring Total</i>	.....	9

All students must pass MMIM ‘100 Question Exam’ by June 30th of their 1st year

Summer Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP7320	Statistical Methods I	3
MMIM6890	Research in MMI	0-3
INDI6020	"On Being a Scientist"	1
<i>Summer Total</i>	.....	6

All MSBS students must pass the Qualifying Exam by the end of the summer semester (August) of their 1st year

Year 2: Masters Students

Fall Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM6030	Current Topics in MMIM	1
MMIM6990	Thesis Research in MMI	7-8
MMIM6020	Advanced Immunology (optional)	0-1
<i>Fall Total</i>	.....	9

Spring Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM6030	Current Topics in MMIM	1
MMIM6990	Thesis Research in MMI	7-8
MMIM6040	Advanced Microbiology (optional)	0-1
<i>Spring Total</i>	.....	9

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM6990	Thesis Research in MMI	6
<i>Summer Total</i>	.....	6

Year 3 (if necessary): Masters Students

Fall/Spring Semesters (9 credits each), **Summer Semester** (6 credits)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MMIM6990	Thesis Research in MMI	9 Fall and Spring; 6 Summer
<i>Total</i>	.....	9 Fall and Spring; 6 Summer

The minimum number of credits required for a MSBS is 40, with a minimum of 20 credits of didactic coursework (letter grade), and a minimum of 10 credits of thesis research. The rest of the credits are approved electives and research in the Medical Microbiology and Immunology track.

Doctor of Philosophy in Biomedical Sciences: Molecular Medicine Track

Department of Physiology and Pharmacology

Bina Joe, Ph.D., chair

Andrew Beavis, Ph.D., track director

The Molecular Medicine (MOME) track (formerly Cardiovascular and Metabolic Diseases) track in the Biomedical Sciences Graduate program at The University of Toledo College of Medicine & Life Sciences on the Health Science Campus nurtures students and provides them with the necessary tools to pursue an independent career in biomedical sciences. The program encompasses a unique interdisciplinary approach to train students to conduct research in the underlying molecular mechanisms of diseases that have profound impact on human health.

The program draws on faculty research strengths in signal transduction, genetics, molecular and cellular biology, gene microarrays, genomics, proteomics, gene knockout and transgenics, tissue culture, and protein and carbohydrate biochemistry. The MOME faculty members are not only drawn from its associated department, the Department of Physiology and Pharmacology, and from the Center for Diabetes and Endocrine Research (CeDER), but also from other departments including the Departments of Medicine, and, Orthopedic Surgery. Modern, well-equipped research facilities are available through the participating departments. The MOME program offers degrees of Doctor of Philosophy (PhD) and Masters in biomedical sciences (MSBS). The program also offers these graduate degrees in combination with the Medical Degree (MD) that is offered by the medical school. Students from the four programs, PhD, MSBS, MD/PhD and MD/MSBS, follow a well-defined program that includes core courses, journal clubs, seminars, laboratory rotations, independent research, and electives in the area of interest. Students select faculty advisors and begin their independent dissertation research following the laboratory rotations in the biomedical science core curriculum. The curriculum is designed to enable students, guided by their advisors, to develop the expertise that prepares them for a successful career in research and education

PhD Program Students: Year 1

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
	Introduction to Biomedical Research	0
	Current Problems and Research Approaches (CPRA) in;	
BMSP6330	CPRA in Proteins	2
BMSP6340	CPRA in Genes and Genomes	2
BMSP6360	CPRA in Cell Membranes	2
BMSP6380	Methods in Biomedical Sciences	2
BMSP6390	Mentored Research (two 5 week lab rotations)	1
<i>Total</i>		9

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6470	Systems Pathophysiology	4
BMSP6350	CPRA in Cell Biology and Signaling	3
BMSP6390	Mentored Research (one 5 week lab rotation)	1
MOME6600	Journal Paper Review in MOME	1
Total		9

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP5320	Statistical Methods I, (required BMS core course)	3
INDI6020	"On Being a Scientist"	1
MOME6730	Research in MOME	3-6
Total		6

PhD Program Students: Year 2 And Beyond

In addition to the BMS core requirements, PhD students in the Molecular Medicine track will be required to take the following courses to graduate:

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME6300	Seminars in MOME (fall and spring) (required in fall and spring semesters of the 2nd, 3rd and 4th years)	1
MOME6500	Advanced Topics in MOME (fall)	3
MOME6600	Journal Paper Review in MOME (fall and spring) (required in fall and spring semesters of the 2nd and 3rd years)	1
BMSP6250	Grant Writing Workshop (spring)	2

Curriculum to include advanced electives in Molecular Medicine or other areas to make up the required number of didactic credit hours. Students will also be expected to present a poster or oral presentation in the annual COMLS Graduate Research Forum in the spring of each year and the Pharmacology Research Colloquium. The Pharmacology Research Colloquium is held on a rotating basis at UTHSC, Michigan State University, the University of Michigan and Wayne State University. It is an annual event in which the students of "pharmacology" departments at the respective Medical Schools have participated in since 1973. These events provide students with excellent opportunities for developing skills in organizing, presenting and discussing their work.

Typical course schedules for years 2-4

PhD Program Students: Year 2**Fall Semester**

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME6500	Advanced Topics in MOME (fall)	3
MOME6300	Seminars in MOME (fall and spring)	1
MOME6600	Journal Paper Review in MOME (fall and spring)	1
MOME6730	Research in MOME and/or	0-4
MOME6890	Independent Study in MOME and/or	0-4
	Electives	0-4
Total		9

The PhD Qualifying Exam is taken at the end of the Fall semester of the second year. Prior to passing the PhD Qualifying Exam, the student carries out their research under the course Research in Molecular Medicine (MOME 6730, 1-9 credit hours) or in some cases Independent Study in Molecular Medicine (MOME 6890). After passing the PhD Qualifying Exam, the student carries out

their research under the course Dissertation Research (MOME 9990).

Spring Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME6300	Seminars in MOME (fall and spring)	1
MOME6600	Journal Paper Review in MOME (fall and spring)	1
BMSP6250	Grant Writing Workshop (spring)	2
MOME9990	Dissertation Research	0-6
	and/or	
	Electives	0-6
Total		9

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME6990	Dissertation Research	0-6
	and/or	
	Electives	0-6
Total		6

PhD Program Students: Year 3

Fall Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME6300	Seminars in MOME (fall and spring)	1
MOME6600	Journal Paper Review in MOME (fall and spring)	1
MOME6990	Dissertation Research	7
Total		9

Spring Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME6300	Seminars in MOME (fall and spring)	1
MOME6600	Journal Paper Review in MOME (fall and spring)	1
MOME9990	Dissertation Research	7
Total		9

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME9990	Dissertation Research	6

PhD Program Students: Year 4

Fall, Spring and Summer

MOME8300	Seminars in MOME (fall and spring)	1
MOME9990	Dissertation Research	8 (fall and spring) ; 5 (summer)
Total		9 (fall and spring) ; 6 (summer)

PhD Program Students: Year 5 and beyond

Fall, Spring and Summer Semesters

All Dissertation Research (MOME9990) Total 1 credit all semesters

The minimum number of credits required for PhD is 90, with a minimum of 20 credits of didactic coursework (letter grade), and a minimum of 30 credits of dissertation research. The rest of the credits are approved electives and research in the Molecular Medicine track.

Master of Science in Biomedical Sciences: Molecular Medicine Track

Masters Program Students: Year 1

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
	Introduction to Biomedical Research	0
	Current Problems and Research Approaches (CPRA) in;	
BMSP6330	CPRA in Proteins	2
BMSP6340	CPRA in Genes and Genomes	2
BMSP6360	CPRA in Cell Membranes	2
BMSP6380	Methods in Biomedical Sciences	2
BMSP6390	Mentored Research (two 5 week lab rotations)	1
Total		9

Spring Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME6600	Journal Paper Review in MOME*	1
BMSP6470	Systems Pathophysiology*	0 or 4
	or	
BMSP6350	CPRA in Cell Biology and Signaling*	0 or 3
MOME6730	Research in MOME	0-8
	or	
BMSP6390	Mentored Research (1 5 week rotation if needed)	0-1
	Electives	0-7
Total		9

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP5320	Statistical Methods I, (required BMSP core course)	3
INDI6020	"On Being a Scientist"	1
MOME6730	Research in MOME	0-3
Total		6

The MSBS MOME Qualifying Examination (successful completion required in summer term) is taken by the end of the first year.

Masters Program Students: Year 2

Fall Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MOME6300	Seminars in MOME	1
MOME6600	Journal Paper Review in MOME	1
MOME6990	Thesis Research	0-7
	and/or	
	Electives	0-7
Total		9

Spring Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6470	Systems Pathophysiology (if not taken in year 1) or	0 or 4
BMSP6350	CPRA in Cell Biology and Signaling (if not taken in year 1)	0 or 3
MOME6300	Seminars in MOME	1

	(required for students in their 2nd year)	
MOME8600	Journal Paper Review in MOME	1
	(required by students in their 2nd year)	
MOME6990	Thesis Research	0-7
	and/or Electives	0-7
Total		9

Summer Semester

Course	Course Name	Credit Hours
MOME6990	Thesis Research	0-6
	and/or	
	Electives	0-6
Total		6

Masters Program Students: Year 3 (if necessary)

Fall/Spring Semester (9 credits each), Summer (6 credits)

Course	Course Name	Credit Hours
MOME6990	Thesis Research	1-9
	and/or	
	Electives	0-8
Total		9 (fall and spring) ; 6 (summer)

The minimum number of credits required for MSBS is 40, with a minimum of 18 credits of didactic coursework (letter grade). A minimum of 10 credits of Thesis Research (MOME 6990) is required for graduation.

The MSBS curriculum includes advanced electives in Molecular Medicine or other areas to make up the 18 required didactic credit hours.

Doctor of Philosophy in Biomedical Sciences: Neuroscience and Neurological Disorders Track

Department of Neurosciences

Robert Mccullumsmith M.D., Ph.D., chair

David Giovannucci, Ph.D., track director

The combination of molecular biology and genetics with modern neuroanatomical techniques is transforming both our ability to examine and to understand the nervous system. Ongoing research by the faculty in the Neurosciences and Neurological Disorders graduate program is providing insights into neurotransmission, sensory system function, development and plasticity of the nervous system, regeneration and repair following neural damage, the basis of neural disease, and behavior. As one of four biomedical science degree programs in the University of Toledo, College of Medicine & Life Sciences, the Neurosciences and Neurological Disorders program is an interdisciplinary course of studies whose primary goal is to train students for independent, creative careers in biomedical research and/or teaching. The program awards both PhD and MSBS in biomedical sciences degrees and participates in the MD/PhD and MD/MSBS combined degree programs. Nationally-recognized, NIH-funded Neuroscience faculty who serve as research mentors are drawn from a number of departments including: Neurosciences, Neurology, Physiology and Pharmacology, Otolaryngology, Psychiatry and Radiation Therapy. Modern, state-of-the-art research laboratory and core facilities are available through the program and these participating departments.

The Neurosciences and Neurological Disorders training program at the University of Toledo on the Health Science Campus offers the PhD, or MD/PhD degrees through the interdisciplinary degree programs in Biomedical Sciences. The primary goal of the doctoral program in Neurosciences and Neurological Disorders is to train students for independent, creative careers in research and/or teaching. The curriculum for the PhD degree consists of a core of concentrated course work in the first year, followed by specialized elective courses and an emphasis on laboratory research. Elective courses are offered in developmental and systems

neuroscience, as well as ion channel function, sensory physiology, and neuropharmacology. During the first two semesters, each student rotates through four research laboratories, conducting short-term projects, gaining exposure to techniques and identifying potential areas for further investigation. At the end of the second semester, each student selects a major advisor who directs the student's doctoral or thesis research. A faculty committee is also jointly chosen by the student and advisor to supervise academic progress toward completion of the PhD or MSBS degree. In addition to 90 credit hours in didactic and other courses, PhD students are required to successfully pass a qualifying exam and to write and defend a research dissertation. *Masters students complete a minimum of 40 credit hours and write and defend a research thesis.

*** MSBS in Neuroscience and Neurological Disorders is not currently offered**

PhD Program Students: Year 1

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
	Introduction to Biomedical Research	0
	Current Problems and Research Approaches (CPRA) in...	
BMSP6330	CPRA in Proteins	2
BMSP6340	CPRA in Genes and Genomes	2
BMSP6360	CPRA in Cell Membranes	2
BMSP6380	Methods in Biomedical Sciences	2
BMSP6390	Mentored Research (two 5 week lab rotations)	1
Total		9

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6470	Systems Pathophysiology	4
BMSP6350	CPRA in Cell Biology and Signaling	3
BMSP6390	Mentored Research (one-two 5-week lab rotation)	1
NNDP6500	Seminar in Neuroscience	1
<i>Spring Total</i>	.....	9

Summer Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP5320	Statistical Methods I (required BMSP core course)	3
INDI6020	"On Being a Scientist"	1
NNDP6730	Research in NNDP	0-3
Total		6

Ph.D Program Students: Year 2

Fall Semester (*= required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP6560	Readings In Neuroscience	1-4
NNDP6720	Current Topics in Neuroscience	1-4
BIOE5620	Cellular Electrophysiology	3
NNDP6730	Research in NNDP	0-4
Total		9

The PhD Qualifying Exam is taken by the end of the Fall semester of the second year.

Spring Semester (*= required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP8500	Seminar in Neuroscience	1
NNDP8540	Journal Paper Review in Neuroscience * (if offered)	0 or 2

NNDP8720	Current Topics in Neuroscience	1-4
INDI8790	Basic & Advanced Light Microscopy (elective)	0 or 4
INDI8860	Electron Microscopy (elective)	0 or 4
BMSP8250	Grant Writing Workshop (elective)	0 or 2
NNDP9990	Dissertation Research in Neuroscience	0-5
Total		9

Summer Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP9990	Dissertation Research in Neuroscience	0-6
Total		6

PhD Program Students: Year 3

Fall Semester (*= required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP9990	Dissertation Research in Neuroscience	0-9
Total		9

Spring Semester (*= required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP8500	Seminar in Neuroscience	1
NNDP9990	Dissertation Research in Neuroscience	0-8
Total		9

Summer Semester (* = required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP9990	Dissertation Research in Neuroscience	0-6
Total		6

PhD Program Students: Year 4

Fall/Spring Terms (9 credits each); Summer (6 credits)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP9990	Dissertation Research in Neuroscience	0-9 Fall and Spring, 6 Summer

PhD Program Students: Year 5 and beyond

Fall, Spring and Summer Semesters

All Dissertation Research (NNDP9990) Total 1 credit all semesters

The minimum number of credits required for PhD is 90, with a minimum of 20 credits of didactic coursework (letter grade), and a minimum of 30 credits of dissertation research. The rest of the credits are approved electives and research in the NND track.

***Master of Science in Biomedical Sciences: Neurosciences and Neurological Disorders Track**

* MSBS in Neuroscience and Neurological Disorders is not currently offered

Department of Neurosciences

Robert Mccullumsmith, M.D., Ph.D., chair

David Giovannucci, Ph.D., track director

The NND track participates in the masters in biomedical sciences training program. Students are expected to complete a core curriculum similar to that of doctoral students but with some of the courses as elective offerings, to experience one or more rotations before selecting a major advisor and thesis laboratory. The minimum number of credit for MSBS is 40 credit hours, with a minimum of 20 credit hours in didactic courses, and a minimum of 10 credit hours of thesis research. Students are also required to successfully pass a qualifying exam and to write and defend a research thesis. Students usually complete the degree requirements in 2-3 years.

Masters Program Students: Year 1

Fall Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
	Introduction to Biomedical Research	0
	Current Problems and Research Approaches (CPRA) in...	
BMSP6330	CPRA in Proteins	2
BMSP6340	CPRA in Genes and Genomes	2
BMSP6360	CPRA in Cell Membranes	2
BMSP6380	Methods in Biomedical Sciences	2
BMSP6390	Mentored Research (two 5 week lab rotations)	1
Total		9

Spring Semester (all are required)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6470	Systems Pathophysiology	4
BMSP6350	CPRA in Cell Biology and Signaling	3
BMSP6390	Mentored Research (one or two 5-week lab rotation)	1
NNDP6500	Seminar in Neuroscience	1
<i>Spring Total</i>	.....	9

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP5320	Statistical Methods I (required BMS core course)	3
INDI6020	"On Being a Scientist"	1
NNDP6730	Research in Neuroscience	0-3
Total		6

First Year Qualifying Examination (successful completion required in spring or summer term)

Masters Program Students: Year 2

Fall Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP6990	Thesis Research in Neuroscience and/or Electives	0-9
Total		9

Spring Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP6990	Thesis Research in Neuroscience and/or Electives	0-9
Total		9

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
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NNDP6990	Thesis Research in Neuroscience	0-6
Total		6

Masters Program Students: Year 3 (if necessary)

Fall/Spring Semesters (9 credits each); Summer (6 credits)

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
NNDP6990	Thesis Research in Neuroscience	0-9
Total		9

Master of Science in Biomedical Sciences: Human Donation Science

Department of Urology

Puneet Sindhwani, M.D. M.S., Chair
Linda Miller, MSBS, Program Director

Professional Science Masters Degree

The Human Donation Science Master Degree (MSBS-HDS, PSM) program is designed to provide entry-level professional preparation for individuals who wish to become an organ procurement transplant coordinator. Organ procurement coordinators facilitate the organ donation process from beginning to end. They are the liaisons between the donor’s family, the coroner, the medical and nursing staff, the organ procurement organization and ultimately the transplant surgeon. As a result, coordinators must skillfully and diplomatically deal with a number of issues, agendas and personalities in order to achieve a successful organ transplant. Combining science coursework with business and management coursework further enables the HDS-MSBS, PSM graduate to step into the professional world of organ and tissue donation and transplantation.

Entrance requirements/prerequisites:

- Baccalaureate degree from a school that is accredited by a nationally recognized body for accreditation of postsecondary education.
- Overall grade point average of 3.0 in undergraduate work.
- Submission of online University of Toledo Graduate School Application.
- Three letters of recommendation (using the University of Toledo forms).
- A minimum of two semesters of coursework in the biological sciences, a minimum of two semesters of coursework in chemistry, and one semester of college algebra or higher.
- Satisfactory completion of a course in medical terminology or pass a medical terminology proficiency examination. Candidates who are unable to pass the medical terminology proficiency examination will be required to participate in a self-study program and pass a re-test.
- The Graduate Record Examination (GRE) and TOEFL are only required for international students.
- Interview, if requested.
- Graduate School application fee.

Although not required, shadowing an organ procurement coordinator is highly recommended.

Persons who are currently practicing professionals in the field of donation and transplantation are also eligible to enroll in this program and complete the curriculum entirely on-line through the distance learning track. All other applicants who meet the above entrance requirements are eligible for the on-campus track.

Fall Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
HDSC5010	Organ Transplant Procurement	3
HDSC5210	Clinical Foundations Organ Donation	6
HDSC5110	Fundamental Concepts and Clinical Practicum I	3
Elective		3
Total		15

Spring Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
HDSC5310	Clinical Aspects Procurement	4
HDSC5120	Clinical Practicum II	2
HDSC5020	Human Donation Science Scholarly Project	3
Elective		3
Elective		3
Total		15

Summer Semester

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
HDSC5130	Human Donation Science Internship	8
HDSC5410	Human Donation Science Capstone Seminar	2
Total		10

Elective Coursework (choose three)

PUBH6000 Biostatistics (fall / spring) 3CR
 HURM 6730 Performance Management (fall / spring) 3CR
 MGMT 6160 Leading with Power and Influence (fall) 3CR
 MGMT6150 Leading and Developing Yourself (fall / spring) 3CR
 LAWM5000 Law and the Legal System (fall) 3CR
 PUBH 6510 Issues in Pandemic Preparedness and Response
 MGMT 6100 Leading Through Ethical Decision Making
 MGMT 6190 Leading Change and Organizational Improvement
 PUBH 6560 Interdisciplinary Crisis Management for Medical Professionals

Total Program Credit Hours (minimum) for MSBS, PSM degree in Human Donation Science is 40 credits.

Medical Physics Programs

Program Director: E. Ishmael Parsai, PhD

Degree Programs

MSBS Medical Physics (Diagnostic Imaging Track)

MSBS Medical Physics (Radiation Oncology Track)

(also PhD in Physics and Astronomy with specialization in medical physics in both tracks is offered through the College of Natural Sciences & Mathematics.)

Accreditations

The MSBS program in Medical Physics and the PhD in Physics and Astronomy with specialization in Medical Physics are accredited by the Commission on Accreditation of Medical Physics Educational Programs (www.campep.org).

Master of Science in Biomedical Sciences: Medical Physics

Programs of study leading to the MSBS degree in Medical Physics are offered by the graduate faculty of the Department of Radiation Oncology and the Department of Radiology. In addition to the basic medical science and radiological physics coursework, a specific course of study is offered in radiation oncology physics or in diagnostic imaging. This course of study includes didactic courses, independent study, and hands-on clinical covering the selected discipline, along with specific technical research culminating in a research project or thesis. The graduate program is committed to excellence in scientific education, clinical experience, and research leading to the professional development of highly motivated and dedicated students. In addition to the capability of creative scientific research, the coursework and clinical experience is intended to provide students with the fundamental knowledge and educational requirement for eventually becoming board certified in their area of study by The American Board of Radiology, The American Board of Medical Physics, or other credentialing body.

Curriculum:

The didactic course curriculum includes the following courses in addition to additional special topic courses and clinical training.

Medical physics core courses include:

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MPHY6310	Anatomy/Physiology	4
INDI6020	“On Being a Scientist” Seminar	1
MPHY6010	Survey of Diagnostic Medical Imaging I	3
MPHY6120	Radiation Dosimetry I	3
MPHY6160	Radiation Biology	3
MPHY6300	Radiation Detection and Measurement	3
MPHY6200	Radiation Protection and Regulation	3
MPHY6110	Survey of Clinical Radiation Therapy	2
MPHY6500	Medical Physics Seminar	1
INDI6990	Thesis Research	10

Typical course curriculum in Medical Physics - Radiation Oncology track include:

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
Radiological Physics		
MPHY6130	Radiation Dosimetry II	3
MPHY6180	Physics of Radiation Therapy	3
MPHY6190	Brachytherapy	3
MPHY6320	Practical Measurements in Radiation Oncology	2

Typical course curriculum in Medical Physics - Diagnostic Imaging track include:

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
MPHY6020	Survey of Diagnostic Medical Imaging II	3
MPHY6060	Principles of Nuclear Medicine	3
MPHY6860	Independent Study in Radiology (CT and MRI)	2

Non-thesis option:

A non-thesis option is available for students who present advanced degrees from previous graduate work which included a scientific thesis or dissertation.

PhD track:

The PhD in Physics with Concentration in Medical Physics: Please refer to the College of Natural Sciences Catalog for additional information regarding this program, and specifically, the Department of Physics and Astronomy section for admission and degree requirements. Information also may be found at <http://www.utoledo.edu/med/depts/radther/>.

Research Facilities

The Department of Radiation Oncology has access to a variety of computer systems for radiation oncology treatment planning, programming, and image analysis. A wide range of radiation measuring equipment is available, including a full range of dosimetry and quality control test equipment, Wellhoffer computerized beam scanning system, an array of ionization chambers, software and hardware packages for film dosimetry and analysis, oscilloscopes, and test phantoms. Also available are multichannel analyzer scintillation detectors, autogamma, and liquid scintillation counters, diode, thermoluminescent dosimetry systems, nanodot dosimeters, digital scanner for chromic film dosimetry system, RIT densitometry package, etc.

The Medical Physics program is housed on the Health Science Campus and the University of Toledo Medical Center (UTMC) where much of the medical physics training is accomplished at the newly built Dana Cancer Center. This state-of-the-art building houses the radiation oncology department and has a division of radiology, medical oncology, and surgical oncology. All the specialists are under one roof and the concept of a true cancer center is practiced. Besides being a leader in stereotactic radiosurgery (SRS) and stereotactic Body Radiotherapy (SBRT), the University of Toledo Medical Center provides IMRT treatment planning with IGRT capabilities, conventional 3D conformal external beam radiotherapy, and other stereotactic neurologic radiosurgery capabilities such as AVM with inverse planning arc modulation technology. Other treatment modalities that students are exposed to are: Brachytherapy low and high dose rate, Radionuclide therapy using P-32, I-131, Sr-89, Ra-223,

etc. There also exists a large Cs-137 irradiator is also available on campus for blood, small animal, or other cellular petri-dish irradiation.

Department of Radiation Oncology Equipment:

- A Varian True Beam Linear Accelerator, capable of producing photon energies of 6MV, 10MV, and 18 MV, and 6X FFF, and a range of electron energies from 6 to 20 MeV in 2-3 MeV increments.
- A Varian Edge Linear Accelerator, capable of producing photon energies of 6MV, 10MV, 6X FFF, and 10X FFF. This is a specialized new Varian product designed for SRS/SBRT cases with 2.5 mm leaves.
- Both accelerators are equipped with latest state of the ART technology including onboard imaging, EPID MV imaging, Rapid ARC (VMAT), and Gating. The Edge unit is also capable of Optical Surface Monitoring System (OSMS) used for patient positioning.
- ARIA patient management system
- A Philips ADAC Pinnacle treatment planning software package for external beam radiotherapy planning,
- Varian Eclipse Treatment Planning system
- MIM software for rigid and deformable image fusion
- A remote afterloading High Dose Rate brachytherapy unit manufactured by Varian for treatment of interstitial, intracavitary and intraluminal tumors and the associated BrachyVision software package for HDR brachytherapy treatment planning
- VariSeed software package used for prostate seed implant program
- A Philips Gemini Large Bore PET/CT unit equipped with Sim package used for radiotherapy treatment simulations
- An array of low dose rate brachytherapy sources of CS-137 for intracavitary treatment
- A fully automated water scanning system manufactured by Welhoffer
- Various film scanning systems such as VIDAR scanners and HOWTEK scanner for normal diagnostics and chromic film dosimetry
- RIT dosimetry software system for dosimetric analysis using films
- BAT ultrasound system
- An array of ionization chambers and electrometers for dosimetry measurements including highly sensitive farmer, and parallel plate chambers, micro chambers, and scintillation chambers.
- Thermoluminescence dosimeter (TLD) system and oven for annealing TLD chips.
- A MicroStar II OSLD system with nanodots for in-vivo dosimetry

Department of Radiology Equipment:

- Multiple fixed and mobile radiographic and fluoroscopic systems
- Image intensifier and flat panel solid state detector fluoroscopic systems
- Computed radiography and digital radiography systems
- Mammography and stereotactic mammography systems
- Multi-slice (16 and 64) computed tomography systems
- 1.5 and 3.0 Tesla MRI imaging systems
- 4 SPECT imaging systems
- A PET/CT imaging system
- Multiple ultrasound imaging systems
- Hospital-wide GE Centricity PACS system
- Terarecon Aquarius Image Processing workstations and image servers.
- Multiple Windows and Linux PC's for image processing and analysis
- Full complement of diagnostic medical physics test phantoms and dosimetry equipment.

Master of Science in Biomedical Sciences: Medical Science

Program Director: Guillermo Vazquez, PhD

The primary goal of this program is to educate and train graduate students who have completed all prerequisites required for medical school but wish to enhance their understanding of the biological sciences and improve their academic credentials for applying to medical school. Beginning on the 2017-2018 academic year, the program offers a complete redesign of the former MSBS-MS program with renewed emphasis on the core-teachings of pathophysiology of disease. The program has been conceived with three primary objectives:

1. Provide clinically relevant, medical and graduate-level education to students who wish to boost their academic standing, towards a long-term goal of pursuing a career in medicine.

2. Create a strong foundation for improved performance in any MD/DO-curriculum, and USMLE step 1 and step 2 exams.
3. Provide basic and clinical research opportunities to broaden student perspective and strengthen their overall portfolio.

The newly redesigned curriculum emphasizes on an organ-systems based approach where clinical and graduate faculty train students in the pathophysiology of disease. This graduate-level course incorporates materials taught to medical students during their first and second years, thus providing foundational information on the MD curriculum. Since pathophysiology of disease is a significant component of the USMLE exams, its inclusion in the new MSBS-MS curriculum has the potential to increase our student scores on Step 1 and Step 2. The MSBS-MS program also provides a unique opportunity for the graduate students to achieve meaningful clinical and/or basic science research experience. UT's basic and clinical science faculty will guide students through their year-round assignment on clinical or basic research. This allows students to learn the tenants of investigational sciences, widen their scope beyond clinical practice, adding a strong component to their portfolios. Students completing the MSBS-MS program with strong academic performance will have confirmed their ability to perform in any medical school curriculum, and therefore greatly strengthen their overall admissions package. The MSBS-MS program also provides students with insights into the medical school interview process with mock interview sessions and guidance from medical school students and faculty. Students meeting all prerequisites for UT medical school and who are in good academic standing within the MSBS-MS program, have a guaranteed medical school interview at the University of Toledo College of Medicine and Life Sciences. Students who successfully complete the program will be awarded the Masters in Biomedical Sciences-Medical Sciences (MSBS-MS). Completion of this degree is a requirement, but not a guarantee of admission, for those MSBS-MS students seeking admission into UT Medical School. In additions, students who subsequently gain admission to the MD degree program will be required to complete a criminal background check prior to matriculation.

If you have previously applied to the MD degree program at the University of Toledo College of Medicine & Life Sciences, and wish to re-apply after completing the MSBS-MS program, you will need to submit a new application to the medical school.

- Applicant must be a U.S. Citizen or Permanent Resident
- Baccalaureate degree from an accredited college or university
- All prerequisites required for medical school must be completed prior to admission into the MSBS-MS program
 - Official MCAT score (28/500 or higher is recommended)) less than 3 years old.
 - Official undergraduate transcripts confirming degree submitted directly to the College of Graduate Studies
- GPA of 3.0 or greater is recommended
- One letter of recommendation
 - Committee recommendation letters are accepted with all signatures
 - Recommendation letters must include your full name
- Personal statement
 - Personal Statements submitted from medical school admission are accepted. A new career goals personal statement is required for MSBS-MS admission.
 - Personal Statements must include your full name
- University of Toledo College of Graduate Studies online application
 - Application Fee submitted at the time of online application
 - Please note: If you have already applied to the University of Toledo Medical School you must submit written authorization to the College of Graduate Studies in order for your medical school file to be accessed. Please do not make this request until you have submitted your application and fee.

Fall Semester		
Course	Course Name	Credit Hours
INDI5450	Molecular Cell Biology	7
INDI 5550	Concepts in Anatomy & Pathophysiology	3
PUBH 6000	Biostatistics	3
INDI 6980	Scholarly Project for Medical Sciences	1
Total		14

Spring Semester		
Course	Course Name	Credit Hours
INDI 5350	Pathophysiology of Organ Systems	10
INDI 5650	Immunology and Medical Microbiology	4
INDI 6980	Scholarly Project	1

Total 15

Summer Semester

Course	Course Name	Credit Hours
INDI 6020	“On Being a Scientist”	1
INDI 6920	Student Seminar Series	1
INDI 6980	Scholarly Project	6
Total		8

Program total minimum number of credits for MSBS degree in Medical Science is 37 credits.

Master of Science in Biomedical Sciences: Oral Biology

Department of Dentistry

Michael Nedley, D.D.S., chair

The oral biology program is restricted to Pediatric Dentistry Residents who are completing their training at the University of Toledo, College of Medicine & Life Sciences and UTMC. The program’s curriculum is designed specific to each Dental Resident and students should consult with their advisor to create their specific Plan of Study.

Summer Session II Year 1

Course	Course Name	Credit Hours
DENT6040	Conscious Sedation I	2
DENT6060	Principles of Behavior & Communicative Management	2
DENT6070	Pediatric Dentistry Literature Review	0.5
DENT6050	Clinical Pediatric Dentistry	0.5
Total		5

Fall Year I

DENT6010	Growth and Development	0.5
DENT6020	Pharmacology I	0.5
DENT6030	Dento-alveolar Trauma I	0.5
DENT6050	Clinical Pediatric Dentistry	1
DENT6070	Pediatric Dentistry Literature Review	0.5
INDI6980	Scholarly Project	1-10
PUBH6000	Biostatistics	3
Total		9

Spring Year 1

Course	Course Name	Credit Hours
DENT6050	Clinical Pediatric Dentistry	1
DENT6070	Pediatric Dentistry Literature Review	0.5
DENT6080	Anatomy and Embryology of the Head and Neck	1
DENT6090	Current Concepts in Dental Microbiology	0.5
DENT6120	Pharmacology II	0.5
DENT6130	Dento-alveolar Trauma II	0.5
DENT6140	Conscious Sedation II	2
INDI6980	Scholarly Project	1-10
Total		9

Summer Year 2

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
DENT6100	Pediatric Medicine Lecture	1
DENT6110	Oral Health Policies	2
INDI6980	Scholarly Project	1-10
Total		5

Fall Year 2

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
DENT6100	Pediatric Medicine Lecture	1
DENT6110	Oral Health Policies	2
DENT6150	American Board of Pediatric Dentistry Review	2
DENT6160	Special Care Dentistry	1
INDI6980	Scholarly Project	1-10
Total		9

Spring Year 2

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
DENT6100	Pediatric Medicine Lecture	1
DENT6200	Oral Pathology	1
INDI6020	“On Being a Scientist”	1
INDI6980	Scholarly Project	1-10
Total		9

Master of Science in Biomedical Sciences: Orthopedic Sciences

Department of Orthopedic Surgery

Nabil Ebraheim, M.D., chair

Martin Skie, M.D., Program Director

Master of Science in Biomedical Sciences (MSBS)

Track Name: Bone Biology and Orthopedic Sciences

The Department of Orthopedic Surgery offers graduate-level courses through the Master of Science in Biomedical Sciences program at the University of Toledo. This is a 2-year program consisting of classes, seminars, and research. The students work with Dr. Martin Skie, Department of Orthopedic Surgery; Beata Lecka-Czernik, Department of Orthopedic Surgery; A. Champa Jayasuriya, Department of Orthopedic Surgery; and Dr. Vijay Goel, Department of Bioengineering. Our unique partnership with the Department of Bioengineering allows our researchers and physicians to have access to not only lab and research facilities, but also to the expertise of scientists in the biomechanics field.

Research in Orthopedic Sciences at the University of Toledo College of Medicine & Life Sciences covers a broad spectrum of topics including:

- Biomechanics
- Biomineralization
- Bone diseases
- Bone tissue engineering and regenerative medicine
- Hand and foot disorders
- Hip and knee replacements
- Spinal injuries and disorders
- Sports medicine
- Stem cell technologies
- Trauma/fixation

Currently offered courses include:

CPRA = Current Problems/Research Applications

Fall Year 1

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BMSP6330	CPRA in Protein Structure and Catalysis	2.5
BMSP6340	CPRA in Genes and Genomes	2
BMSP 6360	CPRA in Cell Membranes	2.5
BMSP6380	Methods of Biomedical Science	2.5
INDI6020	“On Being a Scientist”	1
ORTH6500	Musculoskeletal Anatomy & Orthopaedic Basic Science Seminar	3
Total		15

Spring Year 1

BMSP6350	CPRA in Cell Biology and Signaling	3
ORTH5800	Bone Biology and Physiology	3
ORTH6500	Musculoskeletal Anatomy & Orthopaedic Basic Science Seminar	3
ORTH6990*	Thesis Research	0-10
OR		
INDI6980 *	Scholarly Project	0-10
Total		12

Summer Year 1

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
ORTH5700	Orthopaedic X-ray Conference	2
BMSP5320	Statistical Methods I	3
ORTH6550	Journal Paper Review	1
ORTH6990*	Thesis Research	0-10
OR		
INDI6980*	Scholarly Project	0-10
Total		9

Fall Year 2

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
BIOE5710	Soft and Hard Tissue Biomechanics	3
ORTH5700	Orthopaedic X-ray Conference	1
*ORTH6910	Orthopaedic Trauma	1
*ORTH6920	Orthopaedic Spine	1
*ORTH6940	Adult Reconstruction & Tumor	1-3
*ORTH6960	Upper Extremity and Hand	3
ORTH6500	Musculoskeletal Anatomy and Orthopaedic Basic Science Seminar	3
ORTH6550	Journal Paper Review	1
ORTH6990*	Thesis Research	0-10
OR		
INDI6980*	Scholarly Project	0-10
Total		15

Spring Year 2

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
ORTH5700	Orthopaedic X-ray Conference	1
ORTH6750	Biomaterials in Medicine	3
**ORTH6910	Orthopaedic Trauma	1-3

**ORTH6920	Orthopaedic Spine	1-3
**ORTH6940	Orthopaedic Anatomy	1-3
**ORTH6960	Upper Extremity and Hand	1-3
ORTH6500	Musculoskeletal Anatomy and Orthopaedic Basic Science Seminar	3
ORTH6550	Journal Paper Review	1
ORTH6990*	Thesis Research	0-10
OR		
INDI6980*	Scholarly Project	0-10
Total		15

Minimum number of credit hours for MSBS in Orthopedic Sciences degree completion is 69 for the 2-year program.

* Students who elect to do a basic science project will register for ORTH6990 Thesis Research. Students who elect to do a clinical science project will register for INDI 6980 Scholarly Project. In addition to 59 credit hours in didactic and other courses, students will also take a minimum of 10 credit hours of thesis research or scholarly project. Thesis research will require the student to write and orally defend a thesis, scholarly project will require a written paper and oral presentation of the project.

** In the fall and spring of year 2 the student will choose one of the clinical electives (ORTH 6910, 6920, 6930, 6940, 6950, 6960) to take for each semester. Credit for the clinical elective courses: minimum 1 credit, maximum 3 credits
Additional information may be found at http://www.utoledo.edu/med/depts/ortho/master_program/index.html

Master of Science in Biomedical Science: Physician Assistant Studies

Department of Family Medicine

*Linda Speer, M.D. Chair of Department of Family Medicine
April Gardner, MSBS., PA-C., Program Director*

Accreditation

The University of Toledo Physician Assistant Program is fully accredited by the Accreditation Review Commission on Education for the Physician Assistant, Inc. (ARC-PA). Graduates of accredited programs are eligible to take the national certifying examination offered by the National Commission on Certification of Physician Assistants (NCCPA). Most states require certification in order to practice.

Masters Programs

Physician Assistants (PAs) are health care professionals, prepared and licensed to practice medicine with physician supervision. Within the physician/PA relationship, PAs exercise autonomy in decision-making and provide a wide range of diagnostic and therapeutic services. The role of the Physician Assistant includes provision of primary and specialty care in medical and surgical practices located in rural, urban or suburban areas. Physician Assistant practice is patient care centered but may include education, research and administration duties. The American Academy of Physician Assistants (AAPA) is the national organization that represents graduate PAs. The Student Academy of the American Academy of Physician Assistants (SAAAPA) serves the interests of PA students. The University of Toledo PA Program is a member of the Physician Assistant Education Association (PAEA), which is the national organization representing Physician Assistant education.

Master of Science in Biomedical Science: Physician Assistant Studies

The University of Toledo (UT) Physician Assistant Program is a graduate entry-level professional course of study enabling individuals who hold baccalaureate degrees to become PAs. The program is designed to prepare graduates for primary care practice with emphasis placed on both service to medically under-served populations and the team approach to the delivery of health care. The program integrates graduate level critical thinking and analysis, problem solving, scientific inquiry, self-directed learning and the effective use of modern technology for professional practice that includes elements of research, leadership, education and continued professionalization of the physician assistant occupation.

Admission Requirements

The Physician Assistant Program admits students each Fall Semester only.

To be considered for the Physician Assistant Program, candidates must comply with all of the following:

The completion of all admission requirements to the central application service or CASPA (<https://portal.caspaonline.org/>) by OCTOBER 1. CASPA will be available once the next cycle of application opens.

CASPA submissions must include:

- Completed and signed application form
- Application fee
- Two letters of recommendation
- Transcripts for all colleges/universities attended
- In addition, candidates must complete the supplementary application online and pay the associated application fee.

Applicants to the University of Toledo PA Program must be citizens or permanent residents of the United States. Applicants who have completed any of their previous undergraduate or graduate training internationally must fulfill the requirements of the University of Toledo, College of Graduate Studies for international students, available on the College of Graduate Studies website at www.utoledo.edu/graduate. The University of Toledo PA Program requires applicants to provide foreign transcript evaluation from one of the accepted credential evaluation agencies: ECE or WES. The evaluation will be at the applicant's expense. In addition to the requirement for regular admission, all students from non-English speaking countries must achieve satisfactory scores on the Test of English as a Foreign Language (TOEFL) (unless the international applicant has graduated from a US accredited college or university). All international applicants must also demonstrate that they have adequate financial resources for their graduate education before they can be admitted. The TOEFL score requirements and a copy of the financial statement form are available for viewing at the College of Graduate Studies website at www.utoledo.edu/graduate.

Applicants must have earned a Bachelor level degree with a cumulative 3.00 grade point average to be competitive AND to qualify for financial aid. For those applicants who will receive their Bachelor-level degree in the year that they will matriculate, the degree must be completed by June for those applying for entry into the University of Toledo PA class that begins in August.

The following Minimum Prerequisites must be completed with a grade of B- or better:

1. Human Anatomy (Lab recommended)
2. Human Physiology (Lab recommended)
3. Inorganic/General Chemistry with Lab
4. Organic Chemistry with Lab
5. Microbiology with Lab
6. Introductory Psychology, or upper-level Psychology
7. Additional Psychology Course (Lifespan Psychology recommended)
8. College Algebra, or higher mathematics
9. Medical Terminology (minimum 1 credit hour or pass a medical terminology test)

Notes about Admission Requirements:

Each prerequisite course above must consist of at least three (3) SEMESTER credit hours. All coursework identified above must be current within eight (8) years of admission to the program. The deadline for finishing prerequisite coursework for the class entering in August is June 30th. These are minimum program requirements. All prerequisites must be completed with a grade of B- or better. For courses where separate grades are assigned for lecture and laboratory sections, the candidate must receive a grade of B- or better for BOTH lecture and lab. For applicants enrolled at institutions that use a QUARTER system, credit hours are converted such that five (5) quarter hours = three (3) semester hours. There are many factors involved in the holistic selection process, including but not limited to: cumulative undergraduate (or completed graduate) grade point average, cumulative science grade point average, personal experiences, writing sample, reference letters, familiarity with the PA profession and the University, problem solving and teamwork.

An applicant must complete the general admission requirements specified above. Circumstances which may result in a

provisional admission include: An applicant with a Bachelor's degree in progress (must be completed by June 30th). An official transcript with the degree posted must be received prior to matriculation into the program.

An applicant who has any prerequisite courses to complete at the time of application may be admitted with provisional status, with a clear understanding that remaining prerequisites must be satisfactorily (grade of B- or better) completed prior to June 30th for matriculation into the Program. Official transcripts or other appropriate documentation will be required.

In addition to the above minimum requirements, preference will be given to applicants that have earned a B- or better in any of the following advanced healthcare and science-related undergraduate or graduate courses, including but not limited to: genetics, biochemistry, immunology, physics, psychology, physiology, pathophysiology, pharmacology or mathematics.

A candidate with less than a 3.0 undergraduate GPA may be considered for admission with regular student status only if he/she has completed at least 10 semester hours (15 quarter hours) of applicable coursework at the graduate level and has a minimum GPA of 3.0 in these courses.

Formal healthcare experience and/or shadowing of PAs or other healthcare providers is not required. Candidates with formal health care experience must submit copies of any license, registration, or certification related to that field.

Prior to matriculation, candidates must present evidence that they are currently trained in basic cardiopulmonary resuscitation (CPR) according to American Heart Association standards. This training must be maintained throughout the program of study.

Candidates must demonstrate proof of prior Medical Terminology Course with a grade of B- or better or pass a proficiency exam administered prior to matriculation.

Preference will be given to current Ohio residents, graduates of The University of Toledo, non-traditional and diverse applicants and those with significant health care experience.

The University of Toledo PA Program does not provide advanced placement or advanced standing for any students.

Selection Process:

Candidates for interviews will be selected from those with completed applications (both CASPA and the University of Toledo PA Supplemental Application Form) who meet the minimum entrance requirements. Interviews typically occur in January and February. The selection process is highly competitive and merely meeting minimum entrance requirements does not guarantee an interview or admission to the program. Formal patient contact experience is not a requirement for entrance. There are many factors involved in the selection process, including but not limited to: cumulative undergraduate (or completed graduate) grade point average, cumulative science grade point average, personal experiences, writing sample, reference letters, familiarity with the PA profession and the University, problem solving and teamwork.

Based upon a point scoring system with holistic consideration of each candidate, the Admissions Committee may recommend one of the following:

Acceptance: The review of the candidates scores that are based upon the candidate's completed CASPA application and interviews will be recommended to the University of Toledo, College of Graduate Studies for acceptance. The number of candidates recommended for acceptance will be determined by the PA Program class size of 45 students. Following interviews, candidates are informed of acceptance beginning in March.

Alternate/Waiting List: A limited number of candidates will be listed as alternates and will be notified of this admission status. Candidates not admitted from the alternate list must reapply if they wish to be considered for the following year. Following interviews, candidates are informed of alternate status in March and April.

Non-Acceptance: Candidates not accepted will be notified in writing. Candidates wishing to be considered for the following year must reapply. Candidates not accepted are informed in April and May.

Admission Criteria for "Provisional" Status:

An applicant must complete the general admission requirements specified above. Circumstances which may result in a provisional admission include:

- An applicant with a Bachelor's degree in progress (must be completed by June 30th). An official transcript with the degree posted must be received prior to matriculation into the program.
- An applicant with an undergraduate cumulative grade point average (GPA) less than 3.0 may be admitted with provisional status. Students must achieve a 3.0 in graduate study at University of Toledo by the completion of 15 semester hours or may be subject to dismissal. In the past, candidates with undergraduate GPAs less than 3.0 have not been competitive unless they have demonstrated academic achievement through the completion of a relevant graduate level degree program.
- An applicant who has any prerequisite courses to complete at the time of application may be admitted with provisional status, with a clear understanding that remaining prerequisites must be satisfactorily (grade of B- or better) completed prior by June 30th for matriculation into the Program. Official transcripts or other appropriate documentation will be required.
- Candidates who are unable to pass the medical terminology proficiency examination will be required to participate in a self-study program and retest or satisfactorily complete a medical terminology course at an accredited college or university prior to matriculation in Fall courses.

Technical Standards for Admission

Our objective is to increase the opportunities for persons with disabilities, while maintaining the expectation that all students achieve the goals of the Program. The technical standards for admission establish the expectations and abilities considered essential for students admitted to the Physician Assistant Program in order to achieve the level of competency required for graduation and ultimately practice as a physician assistant. All students admitted to the PA Program are expected to be able to demonstrate the abilities specified below.

Physician Assistant Program students:

- must have the mental capacity to assimilate and learn a large amount of complex, technical and detailed information, to solve clinical problems, and synthesize and apply concepts and information from various disciplines in order to formulate diagnostic and therapeutic plans;
- must have the ability to maintain composure and emotional stability during periods of high stress;
- must have the ability to communicate effectively and sensitively with patients from different social and cultural backgrounds and develop effective professional rapport with patients and co-workers;
- must have the ability to record examination and diagnostic results clearly, accurately and efficiently;
- must have adequate sensory function to fulfill minimum competency objectives for palpation, percussion and auscultation necessary to perform a physical examination;
- must possess sufficient postural control, neuromuscular control and eye-to-hand coordination to use standard medical/surgical instruments and possess sufficient control of the upper extremities to meet the physical requirements for training and for performing a safe physical examination;
- are expected to learn and perform common diagnostic and therapeutic procedures (e.g., phlebotomy, suturing) and interpret the results;
- are expected to have a degree of coordination of motor skills necessary to respond to emergency situations quickly and appropriately.

Candidates are urged to ask questions about the program's technical standards for clarification and to determine whether they can meet the requirements with or without reasonable accommodations. Questions may be directed to the Program Director or Office of Student Services. Revealing a disability is voluntary; however, such disclosure is necessary before any accommodations may be made in the learning environment or in the Program's procedures. Information about disabilities is handled in a confidential manner. Reasonable accommodations will be made to comply with the Americans with Disabilities Act. These require program and institutional approval. Requests for accommodations must be submitted in writing, allowing sufficient time prior to matriculation for action on these requests pursuant to Policy 01061, Nondiscrimination on the Basis of Disability.

Other Requirements

Individuals selected for admission to the program must undergo a general physical examination and provide evidence of up-to-date immunization prior to the start of classes in the first year and again just prior to the beginning of clinical rotations in the second year. In addition, students are required to maintain health insurance and liability insurance coverage. Further information is contained in the College of Graduate Studies Handbook and will be reviewed in detail at orientation.

Curriculum

To remain in good academic standing in the Physician Assistant Program, a student must be able to demonstrate the possession of:

- a) a current cumulative graduate GPA of at least 3.0
- b) a minimum of "B" grade in all PHYA courses except the following courses which require a minimum grade of "C"
 - a. PHYA601 - Basic Genetics
 - b. PHYA613 - Research & Stats
- c) The maximum number of credit hours of "C" which may apply toward a degree is eleven (11) (this number is the 5 ANAT credits + the 3 PHYS credits + the 1 PHYA601 genetics credit + the 2 PHYA613 stat credits)

COURSE SEQUENCE

Semester 1 FALL

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
ANAT5000	Anatomy for Physician Assistants	5
PHYS5050	Physiology for Physician Assistants	3
PHYA5010	Introduction to the P.A. Profession	1
PHYA5100	Prin. of Interviewing & Medical History	3
PHYA5140	Health Care Teams & Systems	2
Total		14

Semester 2 SPRING

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
PHYA5400	Pathophysiology I	2
PHYA5210	Diagnostic & Therapeutic Skills I	2
PHYA5310	Clinical Medicine I	4
PHYA5510	Pharmacology I	2
PHYA5130	Patient Evaluation	3
PHYA6050	Medical Ethics	2
Total		15

Semester 3 SUMMER

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
PHYA5520	Pharmacology II	2
PHYA5410	Pathophysiology II	2
PHYA5340	Clinical Medicine II	3
PHYA5220	Diagnostic & Therapeutic Skills II	1
PHYA6110	Health Promotion & Disease Prevention	1
PHYA6010	Basic Genetics	1
PHYA6030	Intro to Long Term Care	1
Total		11

Semester 4 FALL

<i>Course</i>	<i>Course Name</i>	<i>Credit Hours</i>
PHYA5230	Diagnostic & Therapeutic Skills III	2
PHYA5330	Clinical Medicine III	6
PHYA5430	Pathophysiology III	1
PHYA5530	Pharmacology III	2
PHYA6130	Research & Statistics	2
PHYA6150	Behavioral Science	2

Total 15

Semester 5 SPRING

Course	Course Name	Credit Hours
PHYA6500	Introduction to Clinical Practice	1
PHYA6600	Research Practicum	1
PHYA6610	Scholarly Project I	1
	Clinical Practice (3 rotations)	6
Total		9

Semester 6 SUMMER

Course	Course Name	Credit Hours
	Clinical Practice (3 rotations)	6
PHYA6620	Scholarly Project II	1
Total		7

Semester 7 FALL

Course	Course Name	Credit Hours
PHYA6630	Scholarly Project III	1
PHYA6760	Clinical Preceptorship	4
	Clinical Practice (2 rotations)	4
Total		9

TOTAL PROGRAM HOURS 80

The revised program is pending review.

Clinical Practice consists of a total eight (one-month) rotations, with one in each of the following specialties: emergency medicine, internal medicine, family medicine, long-term care, prenatal/gynecology, surgery, pediatrics, and an elective (which may be any specialty of medicine).

Certificate in Pathology for Post Second Year Medical Students

Amira Gohara, Ph.D., chair

Pathology for Post-Second Year Medical Students Certificate

“Pre-Clinical Pathology Fellowship”

Admission Requirements

- Successful completion of a second year medical school curriculum from an LCME accredited medical school with grades equivalent to a GPA ≥ 3.0 .
- GRE exam not required

Core Courses

Course #	Course Title	Credits
<u>Fall</u>		
PATH6060	Introduction to Surgical Pathology & Cytology	2
PATH6070	Introduction to Clinical Laboratory Medicine	2
PATH6080	Introduction to Postmortem Pathology	2
PATH6890	Independent Study in Pathology	1
<u>Spring</u>		
PATH6060	Introduction to Surgical Pathology & Cytology	2
PATH6070	Introduction to Clinical Laboratory Medicine	2
PATH6080	Introduction to Postmortem Pathology	2

PATH6890	Independent Study in Pathology	1
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Summer

PATH6060	Introduction to Surgical Pathology & Cytology	2
PATH6070	Introduction to Clinical Laboratory Medicine	2
PATH6080	Introduction to Postmortem Pathology	2

Students from LCME accredited medical schools who have completed their second year and are in good academic standing are eligible to apply for this program. While the American Board of Pathology gives up to 1 year credit toward certification for time spent as a Fellow, the Fellowship is not limited to those planning to make pathology a career.

Student Learning Objectives

At the end of the fellowship, the students will be able to:

Autopsy Service

- perform a complete autopsy including evisceration, dissection and examination of the various organs including brain
- describe grossly and microscopically all organs from a given autopsy and provide a clinicopathologic correlation as to the cause of death

Surgical Pathology

- Perform gross and microscopic examinations on surgical specimens
- cut, stain and review frozen sections
- interpret frozen sections
- interpret gross and microscopic surgical pathology specimens

Clinical Pathology

- interpret peripheral blood smears
- provide clinicopathologic correlations for chemistry, microbiology and immunology tests
- perform phlebotomies on in- and out-patients

Electives and Scholarly Activities

- analyze scientific articles
- interpret EM specimens
- prepare and present scientific papers at annual scientific day

Teaching

- teach second year medical school labs