

## Advising for Pre-Medical Students at UM-Flint

(Biology Dept.; updated 3/5/18)

**Most of the following advice also applies to pre-dental students.**

For advising, you can contact the department's academic advisor, Megan Presland, through a link on Biology Department Advising Website (<https://www.umflint.edu/biology/advising-information>) or by contacting the department in person (264 MSB) or by phone (762-3360) to set up an advising appointment.

Visit the UM-Flint Pre-Med Website: <http://www.umflint.edu/advising/pre-medical> for lots of additional information.

The advising information below was extracted from the UM-Flint Catalog with added annotations in italics:

There is keen competition for the limited number of places available in medical schools. Therefore, prospective applicants are urged to plan an alternate career option as they pursue a bachelor's degree. Students are also advised to obtain exact information from their prospective medical schools concerning requirements for admission.

In general, medical schools stress scholastic achievement, especially in the sciences, as a major criterion for admission. Premed students may major in any discipline so long as the requirements of the medical program to which they are applying are fulfilled. Medical schools are looking for well-rounded students with a broad, liberal arts background. Such a background can be demonstrated by pursuing a non-science major or minor, or focused sequences of courses in multiple disciplines. Such factors as the quality of the undergraduate college and the recommendations supplied by its faculty, results of the Medical College Admission Test (MCAT) and *place of residence* are also considered. Personal qualities such as integrity, motivation, leadership, and maturity are often discernible through the applicant's record of nonacademic activities, an autobiographical statement, and the personal interview at the medical school.

Each student who plans to apply for admission to medical school should seek the assistance and guidance of an advisor from the Biology or Chemistry and Biochemistry Departments at the University of Michigan-Flint, and consult the Biology website for more information at <http://www-lb.umflint.edu/advising/pre-medical>

*Most pre-medical student are either biology or chemistry majors, but a more unusual major may make you stand out from the crowd. Consider dual majors. If possible, choose the major that excites your interests the most.* Also, keep optional career paths in mind in case you do not get into medical school or just change your plans in the future. As a minimum, we recommend that the following courses should be completed before applying to medical school:

BIO: 111, 113, 326, 328. *Organismal Biology, Principles of Biology (intro to cell biology, genetics & ecology), Cell Biology, Genetics]*

CHM: 260, 261, 262, 263 or 265, 330, 331, 332, 333. *[Year of inorganic chemistry with labs; year of organic chemistry with labs]*

ENG: One year (typically 111 and 112) *[College Rhetoric, Critical Writing and Reading]*

MTH: Wide variation; some require integral calculus. *[Actually very few medical schools require calculus any more, although the Uniformed Services University Medical School in Bethesda requires a semester of calculus or statistics. Check with the medical schools to which you plan to apply. Some extra math ability gives you "bragging rights" in your application to medical school.]*

PHY: 143 and 145; or 243 and 245. *[When asked what undergraduate courses were most important to preparation for first year of medical school, some first-year medical students said physics! So, take heed! Also consider that if you take calculus, the PHY 243 & 245 courses will give you experience using calculus. Learning calculus is a good mental exercise, but is even better if you can carry over the mathematical abilities learned to subsequent courses. Using calculus in learning physics will increase the probability that you will be able to apply calculus to aspects of medical physiology and pharmacology. Also, be aware that the 200-level physics courses cover fewer basic physics topics (but in greater depth) than the 100-level courses; plan to study omitted topics prior to MCAT.]*

### Pre-medical advisors, in addition, highly recommend:

- BIO: 418, 419, 432, 405, 406. *[Histology, Histology lab; Mammalian Physiology, Microbiology Lecture; Microbiology Lab; pre-med students often remark that our mammalian physiology course (BIO 432) was the single most important course in preparing them for the MCAT (Medical College Admission Test); this may be due to this course drawing on general MCAT topic (e.g. general biology, chemistry and physics) or to increasing the student's reading comprehension of the medical physiology language that shows up in MCAT questions; see <http://www.aamc.org/students/mcat/start.htm> for more info.]*
- CHM: 450, 452. *[Two semesters of biochemistry lecture. Some medical schools now require at least one semester of biochemistry. If you cannot fit the two-semester sequence into your schedule, you can choose a one-semester survey course of biochemistry, CHM 350, which is generally offered every winter semester. The feedback from several students during their first year of medical school is: "the more biochemistry you can get the better."]*

### Courses of special value to be selected according to one's area of concentration in consultation with an advisor:

- BIO: 412, 425, 450. *[Developmental Biology, Immunology, Parasitology; Additional courses to consider include: BIO 319, Human Reproduction and Development, BIO 433, Pre-Medical Gross Anatomy (includes cadaver dissection; medical school admissions department generally advise against such course and recommend something you won't get in medical school, like molecular biology; however, many physicians and medical students who took the course before medical school recommend taking a cadaver anatomy course, because your first year in medical school will be so much easier), BIO 482, Neuroscience (this basic neuroscience course includes clinical case studies and seeks to make the broad topics of neurophysiology and neuroanatomy understandable); BIO 467, Molecular Biology of Prokaryotes, BIO 468, Molecular Biology of Eukaryotes (the foundations of medical treatments are becoming increasingly based on molecular biology. Some understanding of molecular biology is probably a good idea for any premed student. In fact many premed students at UM-Flint choose to pursue the molecular biology and biotechnology program. This program requires most of the courses that a premed student would want to take plus it offers excellent alternate career paths, even with just a Bachelor's degree)]*

- CHM: 340, 366, 367, 451, 453. [*Physical Chemistry, Analytical Chemistry, Analytical Chemistry Laboratory, Biochemistry Lab I, Biochemistry Lab II; Physical Chemistry will give the student a deeper mathematical understanding of thermodynamics, which should enhance understanding of pharmacological and other physiological reactions in the body; Analytical Chemistry and Analytical Chemistry Laboratory will give the student a deeper understanding of how biological and non-biological samples are analyzed for chemical content; The biochemistry laboratory sequence is especially good for students wanting a research project approach to learning biochemistry*]

### More Pre-Medical Advising:

- Try to design your education and extracurricular activities to make you “standout” in some way from other premed students. Medical schools generally want a medical school class with a broad range of individuals. In a recent year, the undergraduate major across the country with the highest acceptance rate into medical school was Music! An individual who can excel in their premed coursework and in something as diverse from science as music will stand out in the applicant pool. Don’t try to force yourself into a major you do not enjoy. If you choose biology or chemistry as a major, consider a minor or a sequence of courses within a minor (and brag about it!) that is unusual for a premed student, such as English, Anthropology, Communication, and History or some other humanity or social science. The Health Sciences Department has an interesting minor in gerontology. Gerontology is a fast growing area of medicine and such a minor might catch the eyes of a medical school admissions committee. You may not be able to fit all of the gerontology minor into your curricular plan, but you can still brag about having completed a series of courses within this or other minors. Also, medical schools look for applicants with a broad undergraduate education. After completing UM-Flint’s general education requirements you should have a broad undergraduate education. To add depth to your breadth of general education, try to take sequences of lower-level and upper-level courses in the same general topic areas (i.e. ethics, literature, cultural studies). When you write your essay to medical school or in your interviews, explain the strengths of your general education background and highlight some of your key courses that contributed to your intellectual growth in areas such as cultural diversity, ethics, literature, etc. Try to select courses that you think will make you more marketable (i.e. strengthen your weaknesses and give you new skills and abilities to add to your “bag of tricks”).

#### Some general education courses to consider:

- If you do not have a fine arts course in mind, students have recommended the following courses: MUS 100, An introduction to Music (essentially a music appreciation course); ART 120, Introduction to Visual Arts (little if any actual art techniques, mostly about art and artists).
- For humanity courses, consider a sequence of courses in philosophy. The premed students who are philosophy majors generally score higher than other premeds on the Medical College Admissions Test (MCAT). To enhance your critical reading and logical reasoning ability, I recommend PHL 101, Introduction to philosophy, or PHL 202, Introduction to Logic, followed by one of the 300-level philosophy course. A less rigorous philosophy sequence that is also of value is a sequence in ethics such as PHL/NSC 168, Introduction to Bioethics, and PHL/HCR 304, Ethics of Health Care. PHL 168 is designed for pre-nursing students, but is appropriate for any student. PHL 304 is not much different than PHL 168, but covers different case-study situations.
- COM 210, Introduction to Public Speaking also is a humanity course. The course teaches some of the “tricks” to becoming a better speaker. All students probably should take this course.
- PSY 100, Principles of Psychology, is a social science required by all medical schools. Medical school web sites often suggest PSY 309, Abnormal Psychology, as a good psychology elective course. Also, PSY 313, Developmental Psychology is a good elective, because it presents how human psychology changes from childhood to old age. Consider other social science courses (e.g. SOC, ANT, HIS, POL, ECN, and many HCR courses) to add breadth to your background.
- Consider a foreign language and or courses in cultural diversity to enhance your cultural awareness. Cultural diversity courses can be found in many departments (e.g. AFA, COM, HIS, POL, SOC, WGS). Of particular note is HCR 362, Cultural Competence in Health Care.
- Consider getting involved in an undergraduate research project. The project does not have to be medically related to impress a medical school admissions committee. Most members of medical school admissions committees are academic clinicians who value research and know the effort and dedication involved. Medical school training stresses “evidence-based practice” in medicine, which is the application of the scientific method in medical practice. Undergraduate research is a step in that direction.
- For students who are interested in a business class, I recommend BUS 201, Principles of Financial Accounting. This course provides a basic understanding of accounting, which could be very useful for a practicing physician who needs to communicate effectively with an accountant.

## Final Notes: Advising for Biology Pre-Medical Students at UM-Flint:

Most pre-med biology majors choose the general program in biology; however, an increasing number of academically strong premed students are choosing the molecular biology and biotechnology program. Molecular biology plays a major role in current medical research such that some exposure to molecular biology is probably a good idea for any pre-med student. Individual interests and academic talents of the student should be factored into the decision to take molecular biology coursework or to pursue the molecular biology and biotechnology program. It is often very difficult to do well in a rigorous course, like molecular biology (BIO 467), if the student does not have a strong interest in the subject area.

An alternative premed program to the B.S. programs mentioned above is the B.A. in human biology. This program was originally designed for pre-physician assistant, and pre-physical therapy students. However, this program now also has Pre-Medical and Pre-Dental Concentration. In general, the B.A. in human biology provides more curricular flexibility for completion of minors or a double major with another Bachelor of Arts degree program (e.g. English, Philosophy, Music, History, Anthropology, etc.)

### General Program in Biology (Bachelor of Science)

Advisors: Megan Presland as well as all regular, full-time biology faculty

The Bachelor of Science Program in General Biology is selected by most biology majors. This program is designed to provide a wide breadth of preparation in biology along with the greatest degree of student choice in selecting their upper-level courses. Like all of the Bachelor of Science programs in biology, this program requires at least pre-calculus mathematics (MTH 120), a year of physics (PHY 143 & 145), the freshman CHM 160 series, six to eight additional credits (depending on program) of higher-level chemistry, plus a foundational set of five, core-biology courses: Organismal Biology (BIO 111); Principles of Biology (BIO 113); Cell Biology (BIO 326); Ecology (BIO 327); and Genetics (BIO 328). Then, with the aid of an advisor, the student may select from a wide range of biology courses to meet their own individual interests and career goals.

### Program in Molecular Biology and Biotechnology (Bachelor of Science)

Advisors: Megan Presland as well as Dr. Joe Susic

The development of recombinant DNA technology, sometimes referred to us as genetic engineering, has radically altered the biomedical sciences. Recombinant DNA techniques have triggered the exponential growth of a new biological field—molecular genetics, or, more generally, molecular biology—which only two decades ago was in its infancy. Fundamental biological problems, untenable only a decade or two ago, are now being addressed using new molecular genetic methods. Recombinant DNA techniques are also revolutionizing disease diagnosis, as the genetic basis for diseases like cancer, muscular dystrophy, and Alzheimer's are being discovered; indeed, almost nightly you can see a story on the news or in the paper that describes a new discover, facilitated by recombinant DNA methods, relating to these and other diseases. Applications of recombinant DNA methods, collectively called biotechnology, are yielding new approaches to disease treatment, drug development, forensics, and even the study of evolution.

The Program in Molecular Biology and Biotechnology provides students with a rigorous curriculum designed to prepare them for a career in this exciting and expanding area of biology. Students in this program will be exposed to state of the art molecular techniques, and students completing this program will be highly qualified to 1) seek employment at academic, industrial, or government laboratories engaged in molecular biology endeavors, or 2) pursue graduate studies in molecular biology and related fields such as microbiology, immunology, or cell biology.

### Program in Human Biology (Bachelor of Arts)

Advisors: Megan Presland as well as all regular, full-time biology faculty

The Bachelor of Arts Program in Human Biology is designed to provide students with a background in human-related biology courses as the focus of a broad and liberal education and in preparation for entrance into a variety of professional programs for healthcare providers. Specific tracks are tailored to serve students interested in careers as a physical therapist, physician assistant, physician or dentist. Students sometimes ask why the Human Biology Program is a B.A. program when all the other biology programs are B.S. programs. The critical differences in general between a B.A. degree and a B.S. degree are the ancillary, non-science courses that are taken. To answer the question specifically for the Human Biology Program, a little history about the program is helpful. The Human Biology Program was originally created in 2002 to serve pre-physical therapy and pre-physician assistant students. The admission requirements for those professional programs require much less science coursework than our Bachelor of Science programs in biology; consequently, the Human Biology Program had significantly fewer required science courses than our Bachelor of Science Programs. Human Biology students then had the ability to select a greater breadth of non-science or pursue one or more non-science minors, if they wished.

Over time, an increasing number of pre-medical and pre-dental students showed interest in selecting the Human Biology Program with the understanding that they could substitute the pre-medical/pre-dental chemistry courses for the much lesser chemistry requirements of the Human Biology Program. In response to this student interest, pre-medical and pre-dental concentrations were added to the Human Biology Program in 2013 when similar pre-professional concentrations were added to our Bachelor of Science programs. Our intent was to give pre-medical and pre-dental students the option to choose the Human Biology Program not to convert the program into a Bachelor of Science program. Hopefully, this explanation helps students understand the historical and philosophical rationale for the Bachelor of Arts designation of the Human Biology Program.

## An Example Pre-Medical Course Plan for the Molecular Biology and Biotechnology Program

Ideally a premed student should start college ready to take calculus in their first semester. With High School Advanced Placement in math and chemistry, the example course plan below could be accelerated substantially.

Semester						Credit hrs.
Fall	BIO 111 (4) Organismal Biology	CHM 260 & 261 (4) Principles of Chem. I	UNV 100 (3) 1 <sup>st</sup> Year Experience	MTH 120 (4) (fq) Pre-calculus	HCR 101 (1) Physical Fitness	15
Winter	BIO 113 (4) Principles of Biology	CHM 262 & 263 (4) Principles of Chem. II	ENG 111 (3) College Rhetoric	CSC 101 (3) (t) Fluency w/ IT & Comp.	HCR 103 (1) Aerobic Conditioning	15
Spring	BIO 326 (4) Cell Biology	ENG 112 (3) English Comp.				7
Summer						
Fall	BIO 405/406 (4) Microbiology	CHM 330/331 (4) Organic Chem. I	PHY 143 (4) College Physics I	PSY 100 (3) (s) Principles of Psych.		15
Winter	BIO 328 (4) Genetics	CHM 332/333 (4) Organic Chem. II	PHY 145 (4) College Physics II	SOC 100 (3) (s) Intro to Sociology		15
Spring	Clinical experience, etc.					
Summer	Clinical experience, etc.					
Fall	BIO 167 (4) Human Anat. & Physio. I	CHM 350 (3) Fundamentals Biochem	PSY 315 (3) (s) Survey of Social Psychology	PHL 168 (3) (h) Philosophy of Bioethics	HCR 103 (1) Aerobic Conditioning	14
Winter	BIO 168 (4) (hw) Human Anat. & Physio. II	BIO 327 (4) Ecology	SPN 111 (4) (gs) Beginning Spanish I	COM 210 (3) (h) Intro Public Speaking		15
Spring	Take MCAT					
Summer	Clinical experience, etc.					
Fall	BIO 467 (4) Molecular Bio. Procaroyotes	BIO 425 (3) Immunology	PSY 309 (3) (hw) Abnormal Psych.	MUS 100 (3) (fa) Intro. to Music		14
Winter	BIO 468 (4) (capstone) Molecular Bio. Eucaryotes	BIO 301 (4) Biostatistics	HCR 362 (3) (hw) Cultural Competence H-C	BIO 447 (3) Biomechanics of Sports		14
					Total credit hrs.	124

## An Example Pre-Medical Course Plan for the General Program in Biology

Ideally a premed student should start college ready to take calculus in their first semester. With High School Advanced Placement in math and chemistry, the example course plan below could be accelerated substantially.

Semester						Credit hrs.
Fall	BIO 111 (4) Organismal Biology	ENG 111 (3) College Rhetoric	UNV 100 (3) 1 <sup>st</sup> Year Experience	MTH 120 (4) (fq) Pre-calculus		14
Winter	BIO 167 (4) Human Anat. & Physio. I	CHM 140 (3) Foundations of Chem.	ENG 112 (3) English Comp.	SOC 100 (3) (s) Intro to Sociology	HCR 101 (1) Physical Fitness	14
Spring	BIO 168 (4) (hw) Human Anat. & Physio. II					4
Summer	Clinical experience, etc.					
Fall	BIO 113 (4) Principles of Biology	PHY 143 (4) College Physics I	CHM 260 & 261 (4) Principles of Chem. I	PHL 168 (3) (h) Philosophy of Bioethics		15
Winter	BIO 328 (4) Genetics	PHY 145 (4) College Physics II	CHM 262 & 263 (4) Principles of Chem. II	CSC 101 (3) (t) Fluency w/ IT & Comp.		15
Spring	BIO 326 (4) Cell Biology	COM 210 (3) (h) Intro Public Speaking				7
Summer	Clinical experience, etc.					
Fall	BIO 405/406 (4) Microbiology	CHM 330/331 (4) Organic Chem. I	BIO 301 (4) Biostatistics	PSY 100 (3) (s) Principles of Psych.		15
Winter	BIO 327 (4) Ecology	CHM 332/333 (4) Organic Chem. II	BIO 425 (3) Immunology	PSY 315 (3) (s) Survey of Social Psychology		14
Spring	Take MCAT					
Summer	Clinical experience, etc.					6
Fall	BIO 433 (5) Pre-Medical Gross Anatomy	CHM 350 (3) Fundamentals Biochem	SPN 111 (4) (gs) Beginning Spanish I			12
Winter	BIO 432 (4) (capstone) Mammalian Physio.	BIO 444 (4) Neuroscience	HCR 362 (3) (hw) Cultural Competence H-C	ART 120 (3) (fa) Intro. to Visual Arts		14
					Total credit hrs.	124

## An Example Pre-Medical Course Plan for the Human Biology Program

Ideally a premed student should start college ready to take calculus in their first semester. With High School Advanced Placement in math and chemistry, the example course plan below could be accelerated substantially and allow a greater possibility of completing a double major or a minor.

Semester						Credit hrs.
Fall	BIO 111 (4) Organismal Biology	ENG 111 (3) College Rhetoric.	UNV 100 (3) 1 <sup>st</sup> Year Experience	MTH 111 (3) College Algebra	HCR 101 (1) Physical Fitness	14
Winter	BIO 167 (4) Anatomy & Physio. I	CHM 140 (3) Foundations of Chem.	ENG 112 (3) English Comp.	MTH 120 (4) Pre-calculus		14
Spring	CHM 260 & 261 (4) Principles of Chem. I					4
Summer	Clinical experience, etc.					
Fall	BIO 168 (4) (hw) Human Anat. & Physio. II	PHY 143 (4) College Physics I	CHM 262 & 263 (4) Principles of Chem. II	SOC 100 (3) (s) Intro to Sociology		15
Winter	BIO 113 (4) Principles of Biology	PHY 145 (4) College Physics II	SPN 111 (4) (gs) Spanish I	CSC 101 (3) (t) Fluency w/ IT & Comp.		15
Spring	BIO 326 (4) Cell Biology					4
Summer	Clinical experience, etc.					
Fall	BIO 405/406 (4) Microbiology	CHM 330/331 (4) Organic Chem. I	SPN 112 (4) (gs) Spanish II	PSY 100 (3) (s) Principles of Psych.		15
Winter	BIO 328 (4) Genetics	CHM 332/333 (4) Organic Chem. II	PHL 168 (3) (h) Philosophy of Bioethics	PSY 315 (3) (s) Survey of Social Psychology		14
Spring	Take MCAT					
Summer	Clinical experience, etc.					
Fall	BIO 433 (5) Premed Gross Anatomy	CHM 350 (3) Fundamentals Biochem	HCR 202 (3) Intro. Gerontology	HCR 103 (1) Aerobic Conditioning		12
Winter	BIO 432 (4) (capstone) Mammalian Physiology	WGS 167 (3) (us) Race, Gender & Sexuality	HCR 362 (3) (hw) Cultural Competence H-C	COM 210 (3) (h) Intro Public Speaking		13
					Total credit hrs.	120

For clinical experience with lots of patient contact, I recommend premed students obtain Emergency Medical Technician (EMT) training through either McLaren Hospital or Genesys Hospital (Genesys EMT website: <http://www.genesys.org/GRMCWeb.nsf/0/45B7983AF9C04E6A8525719C00634D8F?open>; McLaren website: <http://www.glci.com/flint/EMTProgramDescriptionFlint.aspx>). These are seven-month training programs (cost ~ \$750) that involve two days per week for about four hours each day either daytime or evening classes. Students who have done this report really enjoyed the training and work experience, which included lots of opportunities to interact with emergency-room physicians and other medical personnel. Alternatively, some students have completed an accelerated Certified Nurse's Aide course through Genesee Health Careers (cost ~ \$1,400) that only takes three weeks (90 clock hours). Their contact information is: <http://geneseehhealthcareers.org/about/>; G-3308 Miller Rd., Flint, MI 48507 (810-407-8126). Mott Community College offers less expensive phlebotomy courses, but you might want to inquire about job prospects with local hospitals before going that route.

I also highly recommend joining the premed club for additional peer advice on volunteer/clinical experiences. The community service activities of the premed club are good for your resume. Medical school admission committees like to see evidence of leadership qualities in their applicants. Taking the lead in developing and overseeing a service activity is a one way to demonstrate initiative and leadership qualities.

### Worthwhile Flint Area Community Volunteer Activities Recommended by Some Previous Pre-Med Students

Organization	Position	Contact	Number
Big Brother's and Big Sister's program	child mentor	volunteer Coordinator	235-0617
Pierce Elementary	child mentor	Human Resources	760-1000
Carriage Town Ministries	volunteer	volunteer Coordinator	238-6827
Hurley Medical Center-Auxiliary	volunteer	volunteer Coordinator	262-9152
Salvation Army	volunteer	volunteer Coordinator	232-2196
Hospice Advantage	volunteer	volunteer Coordinator	800-HOSPICE

## Some General Advice on Preparing for the MCAT

Plan at least a year ahead for the MCAT. Set aside time several days each week for MCAT preparation involving practice exams (see MCAT website) in combination with content review of key courses (e.g. chemistry, physics, cell biology, genetics, physiology). To enhance your performance on the “verbal” portion of the exam, I recommend getting a book or two on Greek and Latin word roots. Amazon.com has several such books, but be careful which ones you pick. Some are more designed for elementary school level. If you Google “Greek and Latin word roots” you also should find other resources such as a CD-ROM program for building vocabulary. The key to success in this preparation is organization and spreading your practice over a long period of time (cramming for the MCAT is NOT a good idea).

### Upper-level "human-oriented" elective courses often taken by premed students:

- 301. Biostatistics.** *Strong preparation in high school or college algebra and eight credits of biology. (4). Usually offered fall and winter semesters.*

Analysis of quantitative data from biological sources, using basic statistical procedures to elucidate biological phenomena. Mathematical derivations and probabilistic theory not stressed; emphasis on the selection and interpretation of statistical tests commonly used by biologists. Prior knowledge of statistics not necessary. Lecture and recitation. *Also listed as HCR 402.*

- 407. Human Macroscopic Anatomy.** *BIO 111, 113; at least sophomore standing; or consent of instructor. (4). Usually offered summer half semesters of odd numbered year, but has not been offered recently.*

Detailed study of the macroscopic structure of the human body, following a systems approach to the study of human anatomy. Lecture and laboratory.

- 418. Lectures in Histology and Organology.** *BIO 111, 113, 326; admission to the professional program in physical therapy or concurrent enrollment in BIO 410. (3). Usually offered winter semesters of even-numbered years.*

Microscopic structure and function of mammalian cells, tissues, and organs. Lecture. *Also listed as PTP 413.*

- 419. Histology and Organology Laboratory.** *BIO 111, 113, 326; concurrent election of BIO 409; or consent of instructor. (2). Usually offered winter semesters of even-numbered years.*

Identification of mammalian cells, tissues and organs. Laboratory.

- 412. Developmental Biology.** *BIO 111, 113, 326, 328; or consent of instructor. (4). Has not been offered in several years. Future offerings are uncertain at present.*

Survey of the gross morphological, cellular, and molecular aspects of cellular differentiation and organismic development in multicellular eukaryotes. Emphasis on experimental approaches used to analyze eukaryotic development.

- 425. Immunology.** *BIO 111, 113, 326, 328; or consent of instructor. (3). Usually offered every winter semester.*

Physiology and chemistry of resistance to infection and responses to foreign biological substances of a potentially harmful nature. Includes natural immunity, antigen-antibody reactions, immunosuppression and tolerance, the complement system, hypersensitivity, immune deficiencies, autoimmunity, and tumor immunology. Applications include serology. Lecture. *BIO 425 and BIO 485/PTP 414 cannot both be counted toward a Biology major.*

- 432. Mammalian Physiology.** *BIO 111, 113, 326; or consent of instructor. (4). (Bio writing course) Offered every winter semester*

Detailed study of organ and organ-system function in mammals; emphasis on human function. Lecture and laboratory.

- 433. Premedical Gross Anatomy.** *BIO 432 or BIO 167 and 168; admission to the professional program in physical therapy; or consent of instructor. (5). Offered every fall semester.*

Detailed study of the gross structure of the human body. Laboratory involves cadaver dissection. Lecture and laboratory. *Not open to students with credit for BIO 434.*

- 405. Microbiology Lecture.** *BIO 111, 113, 326. BIO 328 highly recommended. (4). (Bio writing course) Offered every fall semester*
- Biology of microorganisms with emphasis on prokaryotes and viruses. Includes microbial anatomy, physiology, growth, genetics, control and medical aspects of host-parasite relationships. Not open to students with credit for BIO 435 without instructor consent.
- 406. Microbiology Laboratory.** *BIO 111, 113 and 326, Prior or concurrent election of (BIO 405) with a grade of C- or better. (4). Offered every fall semester*
- Laboratory study of microbial life, building skills in fundamental microbiological laboratory techniques to include microscopy, aseptic and pure culture techniques and an introduction to the identification, control, and characterization of, as well as applied uses for microbial species. Not open to students with credit for BIO 435 without instructor consent.
- 438. Medical Bacteriology.** *BIO 111, 113, 326, 405, 406; CHM 161, 162. (4). Usually offered every winter semester.*
- Biology of medically significant prokaryotes. Morphology, growth characteristics, virulence factors, pathogenesis, and clinical presentation of bacterial diseases of major medical importance, as well as emerging pathogens. Host immune response, treatment, and prevention stressed. Laboratory exercises emphasize diagnostic techniques as well as virulence mechanisms. Lecture and laboratory.
- 444. Neuroscience.** *BIO 167 and 168; or BIO 432; or PSY 380; and consent of instructor. (4). Offered every winter semester.*
- Principles of neuroanatomy and neurophysiology. Lecture and Laboratory. Not open to students with credit for BIO 482.
- 445. Regional Anatomy.** *BIO 167 and 168; or BIO 432; and consent of instructor (3). Offered every winter semester.*
- Regional human anatomy with emphasis on neurovascular relationships of the head, neck, thoracic cavity and limbs. This course is designed to provide foundational regional anatomy for nurse anesthesia graduate students, but is suitable as well for undergraduate students interested in human anatomy. Lecture and laboratory; Laboratory includes cadaver dissection. Not open to students with credit for BIO 434.
- 450. Parasitology.** *BIO 111, 113, 328; or consent of instructor. (4). Usually offered every winter semester.*
- Study of the major groups of parasitic protists and animals, with particular emphasis on those infecting man and the higher vertebrates. Lecture and laboratory.
- 467. Molecular Biology of Prokaryotes.** *BIO 111, 113, 326, 328, 405/406; CHM 220 or 230; or consent of instructor. (4). Offered every fall semester.*
- Survey of the molecular biology of prokaryotic organisms. DNA replication, DNA repair and recombination, and mechanisms regulating gene expression at the transcriptional and post-transcriptional levels; the interaction of these processes in complex phenomena such as ribosome biosynthesis, cell division, and sporulation. Lecture and laboratory; laboratory focus on recombinant DNA methodologies.
- 468. Molecular Biology of Eucaryotes.** *BIO 111, 113, 326, 328, 405/406; CHM 220 or 230; or consent of instructor. BIO 467 recommended. (4). (Bio writing course) Offered every winter semester*
- Survey of the molecular biology of eucaryotic organisms. DNA replication, DNA repair and recombination, DNA rearrangements, and mechanisms regulating gene expression; the interaction of these processes in complex phenomena such as signal transduction, cell cycle control, cell differentiation, and cancer. Lecture and laboratory; laboratory includes mammalian cell culture and expression of cloned genes in mammalian cells.
- 472. Topics in Medical Genetics.** *BIO 111, 113, 328. (3). Future offerings are uncertain at present.*
- Basic medical genetic concepts and the role of genes in human disease processes and susceptibilities. In addition, students are taught to appreciate the high incidence and broad spectrum of human genetic diseases, to learn the technique and grasp the importance of taking a family history, and to understand the procedures and tools used for diagnosing genetic diseases. Lecture and Discussion.
- 485. Pathology.** *BIO 111, 113, 326, 432; admission to the professional or post-professional program in physical therapy or consent of instructor. (3). Usually offered every fall semesters of odd-numbered years.*
- Human structural and functional disorders primarily related to physical therapy. Lecture.