

Department of Chemistry: Karen E. Torraca, chair. Keith A. Horn, Associate Dean
Faculty: Irmgard K. Howard, John M. Rowley, Karen E. Torraca
Emeritus Professor: Larry W. Christensen
Web site: www.houghton.edu/academics/programs/chemistry
Phone: 585.567.9280

Biochemistry is an excellent path to entering one of the health professions or following a career in biochemical research. A Biochemistry major at Houghton College can lead to such exciting careers as bio-medical researcher, medical doctor, nurse, pharmacist or pharmacologist, nutritionist, physical therapist, or food chemist, to name a few. (For a full description of Pre-Health Professions, see that heading in this catalog, listed under “Biology Department.”) A major in Biochemistry at Houghton College enables a student to learn, in a context of faith, the normal or abnormal paths that one’s body may take, and to understand the ways in which nutrition and pharmaceuticals can best prevent or correct damage to one’s body. Because the Biochemistry major at Houghton College contains a significant liberal arts component as well as its science component, the student may choose, upon graduation, to receive either the Bachelor of Arts or the Bachelor of Science degree in Biochemistry.

Biochemistry: BA/BS (32 hours in major; 16 prerequisites; 20 co-requisites)

Prerequisites (16):

BIOL 151, 152	General Biology I, II.....	8
CHEM 151, 152	General Chemistry I, II	8

Co-requisites (20):

CSCI 211	Programming I.....	4
Math 181	Calculus I	4
PHYS 151, 152	General Physics I, II	8
PSY 309	Statistics.....	4

Required (32) which must include:

CHEM 241, 242	Organic Chemistry I, II	8
BIOL 251	Genetics	4
BIOL 370	Molecular and Cell Biology	4
CHEM 332	Biochemistry	4
CHEM 334	Bioanalytical Lab	1
CHEM 268	Special Topics in Chemistry	2
CHEM 352	Physical Principles	4
BIOCHM 480	Capstone: Seminar in Biochemistry	1
BIOL XXX	Elective.....	4

Research strongly encouraged

COURSE DESCRIPTIONS

BIOCHM 480 Capstone Seminar in Biochemistry (1, S)
 Biochemistry Seminar, the capstone course for the biochemistry major, allows students and professors the occasion to think together about biochemistry: its current topics, history, and issues of science and faith.

Biology BA, BS (major and minor)

Department of Biology: Matthew K. Pelletier, chair. Keith A. Horn, Associate Dean
Faculty: Matthew K. Pelletier, Jamie L. Potter, Aaron M. Sullivan, Kurt Vandock, James M. Wolfe
Part-time: Dr. David A. Brubaker, Eli Knapp
Web site: www.houghton.edu/academics/programs/biology/
Phone: 585.567.9280

General Information: The faculty members of the Houghton College Biology Department enthusiastically engage students as they explore together the living world of God’s creation, from the sub-cellular level to the individual organism to populations and entire ecosystems. Building on the foundation of the College’s

cross-disciplinary, general education curriculum, biology majors learn to integrate their Christian faith with scientific principles and are well prepared to pursue a broad range of vocational callings including applied health careers, bioethics, education, environmental studies, health professions, industry, international development, policy making, research and many others. Houghton College has a rich and long-standing history in preparing students to enter these fields.

Interested in real-world opportunities? Enroll in our pre-medical practicum, in which students live with a Houghton alumnus who is also a physician in order to gain medical “shadowing” time. Alternatively, join the many Houghton students who serve as Emergency Medical Technicians with the Houghton volunteer fire department or travel to a developing country to take *Foundations of Health Development*. Many of our students also participate in Houghton-faculty led programs in Tanzania, where they can take a course in Wildlife Behavior in East Africa, or to travel to Alaska for the Ecology of Alaska course.

Biology: BS (26 hours in major; 8 prerequisites; 28 co-requisites)

Prerequisites (8):

BIOL 151, 152 General Biology.....8

Note unless a grade of C- is earned in the lecture component of both BIOL 151 and BIOL 152 students must enroll concurrently in BIOL 151 or BIOL 152 if also enrolling in 200 level or higher biology courses.

Required (26) which must include:

BIOL 251 Genetics4

BIOL 322 General Ecology.....4

Organismal Biology.....4

One course chosen from following:

BIOL 207 Wildlife Behavior in East Africa

BIOL 231 Comparative Vertebrate Anatomy

BIOL 301 Field Botany

BIOL 315 Marine Biology

BIOL 336 Animal Behavior

BIOL 372 Comparative Animal Physiology

BIOL 482 Senior Seminar2

BIOL XXX Electives12

Experiential Biology (Note credit hours towards the major are only earned if fulfilling this requirement with BIOL 394 or an approved course at Au Sable)

One of the following:

BIOL 394 Collaborative Research, INCL 348 Foundations of Health Development,

PRPR 202A Pre-Medical/Pre-Dental Practicum, an NSF-funded

Summer Science Internship, a Field Course at the Au Sable Institute of

Environmental Studies or completion of the EMT-basic course provided by

Allegany County Emergency Services

Co-requisites (28):

CHEM 151, 152 General Chemistry.....8

CHEM 241, 242 Organic Chemistry8

PHYS 151, 152 General Physics.....8

MATH 181 Calculus I.....4

Pre-Health Professions – Graduates from this major primarily enter graduate programs, some aspect of the health professions (allopathic medicine, osteopathic medicine, podiatry, optometry, dentistry, medical technology, physical therapy), veterinary medicine or environmental science.

Faculty Advisors:

Matthew K. Pelletier (pre-Pharmacy D)

Jamie Potter (pre-medical, pre-osteopathy, pre-dental, pre-optometry, pre-chiropractic)

Aaron M. Sullivan (pre-veterinary, pre-physical therapy, pre-physician assistant)

Through Houghton’s curricula in Integrative Studies and the sciences, interested students will receive excellent pre-professional preparation for a career in a wide variety of allied health fields, including medicine (physician, nurse, physician assistant, nurse practitioner) and dentistry, as well as physical therapy, chiropractic and veterinary medicine. Because the prerequisite courses for these programs may lay the foundation for a major in biology or chemistry, many students desiring to attend these types of training programs major in one of these sciences. However, students may choose to major in any field of study in which they have a strong interest, being careful to fulfill any necessary science requirements as well. In fact, many health profession schools encourage students to major in fields outside of the sciences. In any case, students should pay close attention to the specific admission requirements of schools to which they intend to apply.

Pre-medical Training:

Allopathic (awarding an M.D.) and osteopathic (awarding a D.O.) medical schools are very competitive, receiving far more applications each year than the limited number of available openings. Admission committees seek well rounded individuals with outstanding academic achievement at the undergraduate level. Ensuring these two qualities is vital if an applicant is to receive serious consideration for admission.

Pre-medical students should begin early seeking out opportunities to demonstrate a commitment to community service and to gain practical experience in the medical field. An example of the opportunities offered at Houghton College for students to gain such experiences in the context of elective coursework includes a semester long course in Medical Ethics (which offers a service learning experience in a health related venue).

The two academic benchmarks used by medical schools in screening applicants are the Medical School Application Test (MCAT) and college GPA. Strong performance in both of these is necessary in order to maximize one's chance of being accepted to medical school. Pre-medical students should expect to work diligently from the very beginning of their college experience in order to assure their best preparation for the MCAT. The MCAT is usually taken during the spring of the junior year to support an application for medical school matriculation in the fall following college graduation. Thus, those who intend to follow this timeline for application to medical school should complete the courses needed for MCAT preparation (one year of General Biology, one year of General Chemistry followed by one year of Organic Chemistry, one semester of Calculus followed by one year of Physics) by the end of their junior year. For specific course information please refer to the course descriptions in the appropriate departmental section of the catalog.

Dr. Jamie Potter, pre-medical advisor, can supply more information.

Pre-veterinary Medicine:

Houghton provides a broad, pre-professional education, while offering those courses specified by veterinary medical colleges for admission. Veterinary colleges stress the desirability of a well-rounded post-secondary education. They accept students without regard to their pre-professional major and sometimes after three years or 90 hours of credit. However, most applicants major in biology or chemistry and, on the average, have more than 100 hours of pre-professional training. Because there are relatively few veterinary colleges, the number of students accepted each year into veterinary curricula is small. Therefore, excellence of academic achievement and personal character, as well as familiarity with the profession, is necessary for admission. Contact Dr. Aaron Sullivan, pre-veterinary advisor, for further information.

Pre-Pharmacy D Program (with University of Buffalo)

Biology: BA (26 hours in major; 8 prerequisites; 8 co-requisites; plus prerequisites for admission to UB PharmD program)

Prerequisites (8):

BIOL 151, 152 General Biology 8

Required (26) which must include:

BIOL 217, 218 Human Anatomy and Physiology..... 8

BIOL 242 Microbiology 4

BIOL 251 Genetics 4

BIOL 482 Senior Capstone: Senior Seminar 2

BIOL XXX Electives 8 (*to be met at UB*)

Co-requisites (8):

CHEM 151, 152 General Chemistry..... 8

UB prerequisites for Admission to UB PharmD Program

CHEM 241, 242 Organic Chemistry I, II..... 8

CHEM 332 Biochemistry 4

MATH 182 Calculus II 4

PHYS 151 General Physics I 4

PSY 309 Statistics 4

Two writing courses required (one meets Integrative Studies)

One social behavioral science course (meets one Community IS requirement)

The PharmD program is a 3-year (Houghton) plus a 4-year (UB) program and acceptance to the University of Buffalo is not guaranteed.

Pre-physical Therapy (Biology BA major)

Faculty not listed above: Deanna Hand, D. Brandon Hoffman, Irmgard K. Howard, Richard A. Jacobson, Sandra D. Johnson

Web site: www.houghton.edu/academics/programs/biology/pre-pt.htm

A pre-physical therapy track is available for students who are interested in pursuing graduate studies in physical therapy. A number of courses in physical education/athletic training are required for this track.

Pre-Physical Therapy Emphasis: Biology BA (30 hours in major, 8 in prerequisites, 20 in co-requisites)

Following eight hours of general biology (prerequisite), the pre-physical therapy program consists of 30 hours in biology and physical education that must include the following:

BIOL 217,218	Human Anatomy and Physiology I & II	8
BIOL 251	Genetics	4
BIOL 482	Senior Capstone: Seminar	2
PHED 330	Physiology of Exercise	4
PHED 341	Kinesiology	4
BIOL XXX	Electives	8

Plus an additional 20 hours of co-requisites:

CHEM 151, 152	General Chemistry.....	8
PHYS 151, 152	General Physics.....	8
MATH 181	Calculus I.....	4

Minor: (14.5-16 hours) This pre-physical therapy/athletic training minor must be taken with the pre-physical therapy program.

Required classes

PHED 246	Care, Prevention & Management of Athletic Injuries 2	
PHED 308	First Aid and Safety (2) <i>or</i>	
PHED 108	First Aid/CPR/AED (.5)	
PHED 247	Recognition and Evaluation of Athletic Injuries.....	4
PHED 347	Therapeutic Modalities.....	2
PHED 348	Therapeutic Exercise Mgmt. of Injuries.....	2
PHED 281	Pre-PT Field Experience I.....	2
PHED 381	Pre-PT Field Experience II	2
	Total.....	14.5-16

COURSE DESCRIPTIONS

PHED 281 Pre-Physical Therapy Field Experience I (2, F)

Mastery of competencies in injury prevention, recognition, and assessment; taping, and bracing techniques; understanding of the lower extremity; and medical documentation. *Requires 25 hours of observation in each of three settings: orthopedics, pediatrics, and geriatrics, with an additional 25 hours assisting with rehabilitation in the Houghton College training room. (Hours logged prior to taking this class may count with instructor's pre-approval.) Pre-PT majors only. Pre-/Co-Requisite: PHED 247.*

PHED 381 Pre-Physical Therapy Field Experience II (2, S)

Mastery of competencies in injury prevention, recognition, and assessment; taping, and bracing techniques; understanding of the back, and upper extremity; and developing rehabilitation programs. *Requires 25 hours of observation in each of three settings: orthopedics, cardiac, and neural rehabilitation with an additional 25 hours assisting with rehabilitation in the Houghton College training room. (Hours logged prior to taking this class may count with instructor's pre-approval.) Pre-PT majors only. Pre-/Co-Requisite: PHED 348.*

(For other descriptions, see the appropriate section: biology, chemistry, math, physics, physical education)

Medical Technology with a major in Biology (BS)

Web site: www.houghton.edu/academics/programs/biology/med_tech2.htm

The program in medical technology which leads to a BS in biology requires that the student complete 94 hours of course work at Houghton College and then transfer to Robert Packer Hospital (Sayre, PA) or another approved program to complete a major in biology and a minor in chemistry.

The following courses must be taken at Houghton:

All integrative studies requirements

BIOL 151, 152	General Biology.....	8
BIOL 242	Microbiology	4
BIOL 251	Genetics	4
BIOL 365	Immunology.....	4
CHEM 151, 152	General Chemistry.....	4, 4
CHEM 241	Organic Chemistry I.....	4
CHEM 277	Analytical Chemistry.....	4
MATH 115	Intro to Calculus	4
or		
MATH 181	Calculus I.....	4

If a student plans to attend a non-affiliated medical technology program, s/he must petition for approval of the program during his/her junior year. Enrollment in hospital programs is limited by small class size, and there is no guarantee of admission. Usually a cumulative grade point average of at least 3.0 is needed in order to be a successful applicant. Students who choose not to continue in the medical technology (clinical laboratory science) program or who are not admitted to the professional curriculum may complete a year in biology or general science during the senior year.

Following successful completion of the senior year in the hospital program, students are qualified to sit for the national certification exams. These are administered by the Board of Registry of Medical Technologists and the National Certification Agency for Medical Laboratory Personnel.

Biology: BA (26 hours in major; 8 prerequisites; 8 co-requisites)

Prerequisites (8):

BIOL 151, 152	General Biology.....	8
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Required (26) which must include:

BIOL 251	Genetics	4
BIOL 482	Senior Capstone: Senior Seminar.....	2
BIOL XXX	Electives	20

Co-requisites (8):

CHEM 151, 152	8
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Graduates from this program primarily enter the field of science teaching in secondary schools. Students interested in working toward certification to teach Biology at the middle and high school levels can do so by double-majoring in Biology and Adolescence Education (ADE). Please see the Education Department section of this catalog for details. For further information on the biology programs, contact Professor Matthew Pelletier at matthew.pelletier@houghton.edu.

Environmental Programs

Environmental programs at Houghton take advantage of the college's location in the Allegheny Plateau (ranging in elevation from 1000 to 2500 feet), with access to forest, river, and lake ecosystems, and the Atlantic Ocean. In addition, Houghton's 1300-acre campus has forest and field areas for study. The 91-acre Spring Lake preserve, incorporating an old growth forest and undeveloped kettle lake within eight miles of the campus, is available for environmental research.

Two Houghton programs emphasize Christian stewardship of the creation as well as environmental awareness and analysis. The BA/BS major in biology with environmental emphasis prepares students for careers in environmental education, research and analysis, and further study in graduate program. Field-oriented courses complement a strong biology background, including at least one course at AuSable Institute of Environmental Studies (see Off-Campus Programs section), a center for Christian environmental stewardship. The environmental stewardship minor (see below) for science and non-science majors provides background for responsible stewardship. Required courses include Local Flora and Natural Resource Management. A senior seminar offers exposure to environmental leaders at the local, state, and national level. For further information on the environmental programs, contact Professor James Wolfe at james.wolfe@houghton.edu.

Biology with Environmental Emphasis: BA (26 hours in major; 16 co-requisites):

Prerequisites (8):

BIOL 151, 152	General Biology.....	8
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Required (26) which must include:

BIOL 251	Genetics	4
BIOL 301	Field Botany	4
BIOL 322	General Ecology.....	4
BIOL 482	Senior Capstone: Senior Seminar.....	2
BIOL xxx	At least one course with zoological emphasis	4

Field experience requirement fulfilled by:

- a) at least one biology course at the AuSable Institute of Environmental Studies (max. 8 hours), or
- b) field course (4) at another accredited institution, or
- c) significant intern or work experience

Co-requisites (16):

CHEM 151, 152	General Chemistry I, II.....	8
ESCI 101	Physical Geology.....	4
ESCI 212	Environmental Earth Science.....	4

Recommended courses include the following:

REC 401	National Resource Management.....	4
SOC 309	Statistics.....	4

Biology with Environmental Emphasis: BS (26 hours in major; 36 co-requisites)

Prerequisites (8): see BA above

Required (26): see BA above

Additional co-requisites (20):

CHEM 241, 242	Organic Chemistry	8
MATH 181	Calculus I.....	4
PHYS 151, 152	General Physics I, II.....	8

Recommended courses: see BA above

The BA or BS in biology with environmental emphasis prepares students for careers in environmental education, analysis, and research. Students can take the New York state civil service exam for application as a conservation biologist to the NYS Department of Environmental Conservation.

Biologist (wildlife) (18 hours required): BIOL 105 Conservation Biology (4), Wildlife Biology, Animal Ecology, BIOL xxx Special Topics: Ornithology (4), BIOL 211 Ecology of Alaska (4), REC 401 Natural Resources Management (4).

Biologist (ecology) (18 hours required): BIOL 151 General Biology (4), Animal Ecology, BIOL 301 Field Botany (4), Forest Ecology, BIOL xxx Special Topics: Limnology (4), BIOL 211 Ecology of Alaska (4), BIOL 220 Biological Oceanography (2).

Forestry (emphasis within the Biology major, minor)

Faculty: faculty from SUNY-ESF Ranger School

Web site: www.houghton.edu/academics/programs/biology/forestry.htm

In a world of increasing human effects on world ecosystems, stewardship of forest resources is increasingly important, from ecological, aesthetic, and economic viewpoints. Deforestation in both tropical (tropical rainforest and savannas), temperate and coniferous forest (forest fragmentation and logging in coniferous forests) regions has been in the headlines of popular media for some time. Houghton's programs capitalize on our present resources (a large forested main campus) and look to the future of mission organizations seeking out people with a background in forestry. The program, which includes a minor in forestry and a forestry emphasis within the biology major, is based on a cooperative agreement with the State University of New York – College of Environmental Science and Forestry using the Forest Technology program at the Ranger School based at Wanakena in the Adirondack Park. The Ranger School was established in 1912 and is one of the oldest forestry programs in the country leading to an A.A.S. degree in forest technology. It is supported by the strength and reputation of SUNY-ESF. The Forestry Technology program is a rigorous 48 credit hours taken over an extended year at the Wanakena campus. Graduates from the Ranger School program have gone on for advanced degrees in forestry, jobs in industry and wildlife management, as well as entered the Peace Corps.

Students have the option of taking fall semester at the Ranger School and transferring back the credits for a forestry minor or spending the whole year (fall and spring semesters) receiving the A.A.S. degree from SUNY-ESF as well as the forestry minor. There are three options, based on ultimate educational and career goals.

General prerequisites (SUNY-ESF Ranger School requirements) required of all participants:

ECON 201	Introduction to Economics.....	2
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ECON 210	Principles of Microeconomics <i>or</i>	
ECON 211	Principles of Macroeconomics	2
	Electives	6
BIOL 151/152	General Biology I and II	8
MATH 115	Introduction to Calculus.....	4
	Writing courses	8
	Total.....	30

Option A – Biology major who wants a forestry minor – fall semester

Forest Ecology (counts towards Houghton biology major)	4
Courses counting for the minor	
Dendrology.....	3
Introduction to Forest Measurement and Statistics	4
Spatial Analysis of Forest Resources.....	5
Total.....	12
Additional courses taken but <u>not</u> transferred back:	
Introduction to Surveying	4
Leadership and Forest Technology.....	4

Option B – Biology major who wants a forestry emphasis – fall and spring (courses count for Houghton biology major)

Dendrology (fall).....	3
Forest Ecology (fall)	4
Silviculture (spring).....	5

These students will graduate with an A.A.S. in Forest Technology (SUNY-ESF Ranger School)

These students will take the fall courses indicated in Option A plus spring courses of:

Silviculture.....	5
Forest Inventory Practicum.....	2
Timber Harvesting, Transportation, and Utilization	5
Forest Protection	5
Intro to Wildlife and Recreation Management	4
Forest Management	3

- Option C** – non-Biology major who has the necessary prerequisites
- Can take the fall program as outlined in Option A and earn a forestry minor.
 - Can take fall and spring programs as outlined in Option B, earns:
 - Biology minor
 - Forestry minor
 - A.A.S. degree from SUNY-ESF Ranger School

Environmental Stewardship minor

The environmental stewardship minor provides background for students who plan careers that intersect with environmental issues. The minor is supradisciplinary.

Required courses:

BIOL 214	Wildlife Biology or	
BIOL 215	Local Flora and Vegetation*.....	4
BIOL 475	Environmental Stewardship Senior Seminar	1
ESCI *	4
REC 401	Natural Resource Management.....	4
	Total:	13

*Biology majors with environmental emphasis (where such courses are duplicated or superseded) would substitute Atmospheric Science (ESCI 224), and World Regional Geography (POLS 210).

Recommended courses: BIOL 105 Conservation Biology (4); an internship or independent study with environmental management is strongly recommended (1-2).

Biology minor: 12 hours above BIOL 151, 152

COURSE DESCRIPTIONS

BIOL 103 Fundamentals of Biology (4, F, S)
Principles of biological structure and function, particularly as they relate to humans. Three lecture, three laboratory hours each week. Lab Science or 2nd Science.

BIOL 105 Conservation Biology (4, F12)
Principles of conservation biology including history of conservation, structure of aquatic and terrestrial ecosystems, endangered species and extinction, management, and Christian stewardship. Labs emphasize analysis of aquatic and terrestrial ecosystems. Three lectures, three laboratory hours each week. May not be used toward the biology major or minor. Lab Science or 2nd Science.

BIOL 151, 152 General Biology (4/4, F/S)
Two-semester survey; preparation for advanced work. 151 includes ecology, plant and animal taxonomy and physiology, and animal behavior; 152 includes cell biology and metabolism, genetics, and origins. Three lecture, three laboratory hours each week. Note: BIOL 151 or permission is prerequisite to BIOL 152. BIOL 151 and 152 are prerequisites for major level courses above 200. Lab Science or 2nd Science.

BIOL 207 Wildlife Behavior in East Africa (4, S)
(See course description in Off-Campus Programs - Tanzania section.)

BIOL 211 The Ecology of Alaska (4, M13)
Study of Alaskan ecology through field experiences to Anchorage, Denali National Park, State Museum at Fairbanks, Tetlin Wildlife Refuge, Valdez, Kenai Fjords National Park, and Homer. Research paper on Alaska ecology and a daily journal required. Est. fee above tuition is \$1,500. Prerequisite: BIOL 152.

BIOL 215 Local Flora and Vegetation (3, F)
Field identification of local ferns, shrubs, trees, and herbaceous flowering plants. Lecture covers broader vegetational ecosystems of North America. Small herbarium required. Two lecture, three laboratory hours each week. *May not be used toward the biology major or minor.* Lab Science or 2nd Science.

BIOL 217 Human Anatomy and Physiology I (4, F)
Systematic study of structure and function of the human organism, including microanatomy of organs. General organization of the body, basic tissues, and the integumentary, skeletal, muscular, and nervous systems. Three lecture, three laboratory hours each week. *Does not count for major or minor credit except where required for graduate programs and upon permission of the department chair.* Lab Science or 2nd Science.

BIOL 218 Human Anatomy and Physiology II (4, S)
Sequel to BIOL 217. Endocrine, cardiovascular, lymphatic, respiratory, digestive, urinary, reproductive systems; acid-base and fluid-electrolyte balance. Prerequisite: BIOL 217 or permission. Three lecture, three laboratory hours each week. Note: BIOL 217 and 218 are designed to fulfill the certification requirements for the physical education major and admission requirement for some schools of nursing and physical therapy. *Does not count for major or minor credit except where required for graduate programs and upon permission of the department chair.* Lab Science or 2nd Science.

BIOL 231 Comparative Vertebrate Anatomy (4, S13)
Comparative study of vertebrate structure. Laboratory includes dissection and detailed study of representative vertebrates. Two lecture, six laboratory hours each week.

BIOL/PHED 232 Epidemiology (2, M13)
This course will study the cause and transmission of human diseases within a population relating not only to the infectious agent but also the genetic makeup of the community and the social, behavioral, economic and cultural factors of the people affected. Lectures will address the history of public health and epidemiology including cost/benefit analyses, public health policy, and the implications of case reporting to the CDC and local public health departments. The basic principles of the science of epidemiology, with an emphasis on identifying patterns and formulating testable hypothesis to the disease outcome, understanding the types of epidemiological studies, clinical and community trials and the essential biostatistics involved in any experimental design will be addressed. *Does not count for major or minor credit in biology.*

BIOL 242 Microbiology (4, F)
Survey of viruses, prokaryotic organisms, and fungi with theoretical and applied approaches to morphology, metabolism, genetics, biotechnology, and host-parasite relations. Three lectures, three laboratory hours each week. Prerequisite: BIOL 151, 152 or permission.

BIOL 251 Genetics (4, F)
Principles of inheritance in living organisms, including the modern concepts of “gene” action and DNA structure and function. Three lecture, three laboratory hours each week. Prerequisite: BIOL 152 or permission. Lab Science or 2nd Science.

BIOL 301 Field Botany (4, F)
Introduction to taxonomy, systematics, and ecology of vascular plants. Course includes field trips throughout western New York and northwestern Pennsylvania; plant identification and classification; develop extensive herbarium. Two lecture, six laboratory hours each week.

BIOL 315 Marine Biology (4, OD)
Comprehensive study of marine ecosystems including the foundations of physical and chemical oceanography as they impact the ecology of marine organisms. Overview of structure, physiology, and ecology of marine life from phytoplankton to whales. Labs cover the representative marine divisions (plants) and phyla (animals) and may include a field trip to the northeast Atlantic coast.

BIOL 320 Limnology (4, OD)
Introduction to freshwater aquatic ecosystems with emphasis on lakes. Includes the study of physical, chemical, and biological factors which influence ecosystem function and health. Lake management and conservation included. Labs cover field analysis of a local lake ecosystem culminating in a comprehensive report. Three lecture and three laboratory hours each week.

BIOL 322 General Ecology (4, S)
Study of the interrelationships among living organisms, their physical and biological environment, and human impacts. Laboratory introduction to ecological techniques and field studies of local and state ecosystems. Three lecture, three laboratory hours each week.

BIOL 336 Animal Behavior (4, S)
Provides an introduction to the biological study of animal behavior. Lecture topics will focus primarily on why animals behave as they do and, to a lesser degree, how they get the job done. Topics to be covered include: genes and behavior, learning, organization of behavior, communication, mating systems, parental investment and cooperation. Three lecture, three laboratory hours each week. Prerequisite: BIOL 151, 152.

BIOL 365 Immunology (4, S13)
Theoretical and clinical approaches to study of innate and adaptive immune systems: antigen recognition, immune response, immune system, and its pathologies. Three lectures, three lab hours each week.

BIOL 370 Molecular and Cell Biology (4, F)
The course provides an introduction to the biochemistry of cells, transport across membranes, cell-to-cell signaling, organelle function, and protein targeting, with an emphasis on methods in molecular and cell biology. Three lecture hours and one three-hour lab per week. Labs will focus on molecular techniques such as cloning, PCR, generation and purification of recombinant proteins, and blotting techniques (DNA, RNA, and Protein). Prerequisite: BIOL 251.

BIOL 372 Comparative Animal Physiology (4, OD)
General consideration of functional processes in animals with emphasis on the comparative aspects. Three lecture, three laboratory hours each week.

BIOL 374 Human Genetics and Disease (4, S12, 14)
Our understanding of human genetics is increasing at an incredible pace. This course will explore a number of modern topics including the Human Genome Project, human genetic diseases and gene therapy, human genetic testing, human genetics and behavior, and quantitative traits. Connections between human genetics and society will also be explored. Three lecture hours, optional three-hour lab. Prerequisite: BIOL 251.

BIOL 380 Pathogenic Microbes (4, S12)
Diseases caused by common bacteria, fungi, parasites and viruses in mammals and plants. Topics include classification, immune response, pathogenesis, virulence mechanisms, host-vector-pathogen paradigm, diagnosis, and control of infectious microorganisms. Discussion of current literature to further develop understanding and significance of pathogenic microbes and their diseases. Three hours lecture, two hours discussion/seminar. Prerequisites: BIOL 151/152 and 242.

- BIOL 382 Embryology and Endocrinology** (4, F)
 Study of morphogenesis and biochemical processes involved in development, with emphasis on vertebrates. Three lecture, three laboratory hours each week. Prerequisite: BIOL 251.
- BIOL 393 Summer Collaborative Research in Biology** (1-4, Summer)
 Summer research in collaboration with a biology faculty member focusing on current areas of research including immunology, pathophysiology, molecular genetics, animal behavior, and forest/freshwater ecosystem analysis. Students work intensively with a faculty member over the course of four weeks during the summer. Prerequisite: BIOL 151, 152. Permission of instructor required.
- BIOL 394 Collaborative Research in Biology** (4, F, S)
 Research in collaboration with a faculty member focusing on current research in areas of immunology, molecular genetics, animal behavior, and forest/water ecosystem analysis. Students work in small teams reviewing literature, designing projects, performing experiments, collecting and analyzing data, and writing up their work in manuscript form. Prerequisite: BIOL 151, 152. Permission of instructor required.
- BIOL 195, 295, 395, 396 Special Topics** (1-4, F & S)
 Courses designed to meet the individual needs of advanced students in such areas as medical terminology, virology, disease pathogenesis, animal behavior, and research in biology. Some of the courses include laboratory. Lab Science or 2nd Science.
- BIOL 475 Environmental Stewardship Seminar** (1, OD)
 The course focuses on examining environmental issues and problems in light of the Christian faith with the goal of developing a personal stewardship ethic. Beginning with local environmental problems, and then moving to global issues and ethics. Outside speakers from the larger community, including representatives from the NYDEC, The Nature Conservancy, and local politicians.
- BIOL 480 General Science Seminar** (1, S)
 Written thesis and oral presentation on a topic selected for interdisciplinary breadth describing current scientific research in the area of the student's concentration, based on a thorough review of scientific literature.
- BIOL 482 Senior Capstone: Senior Seminar** (2, S)
 Discussions on history of biological science, ethical problems in biology and health related issues, origins and biotechnology and society as well as environmental issues are covered. Open only to majors.
- BIOL 391, -2; 491, -2 Independent Study** (1, 2, 3, or 4)
 Research under the supervision of a biology department faculty member. Maximum total five credits.
- BIOL 496 Honors in Biology** (4)
- PRPR 202A Premedical-Pre-dental Practicum (P/U)** (3, May)
 Observation and practical experience with physician or dentist on a one-to-one basis. Preparation and sharing of experiences on the Houghton campus. Open only to serious medical or dental school candidates.

