

# BIOLOGICAL SCIENCES

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**Distinguished Professor: Filbin**

**Marie L. Hesselbach Professor: Eckhardt**

**Professors:**

Chappell, Dottin, Foster, Goldfarb, Henderson, Lipke, Raps, Shah

**Associate Professors:**

Angulo, Bargonetti-Chavarria, Figueiredo-Pereira, Persell, Rockwell, Schmidt-Glenewinkel

**Assistant Professors:**

Alaie, Brazill, Loayza, Ortiz, Qiu, Zhong

**Advisers:**

Every faculty member serves as an adviser. Advisers are assigned to majors on an individual basis. Contact the department office.

**HEGIS Codes: 0401 (BA); 0499 (BA/MA in Biotechnology);**

**0401/1299 (BA/MA in Environmental & Occupational Health);**

**1223.01/0401 (BS/MA in Biotechnology)**

Majors Offered	Options in Degree	Number Credits	Recommended/ Required GER	Prereq	Recommended Minor
BA in Biological Sciences	Major I - for students preparing for graduate study, medicine, dentistry, secondary school teaching, biotechnology and industry	37 plus 33.5-36.5 credits in required additional science and math courses	1B: Math 150 2E: BIOL 100,102 P/D (C, D): BIOL 100, 102	MATH 101 or equiv. MATH 125/126 or equiv.	12 credits in a field approved by faculty adviser. Although other minors may be taken, chemistry is the usual minor, as the required courses CHEM 102-105 and 222-224 fulfill the minor requirements. For students preparing to teach biology at the secondary school level, secondary education is an appropriate minor.
	Major II - for students preparing to teach in elementary schools	26 plus 12 additional science credits and 6 credits in math	1B: MATH 104 1C: HIST 151 2A: ENGL 220 2B: GEOG 101 3B: exempt	MATH 101 or equiv MATH 125/126 or equiv.	Childhood education (grades 1-6) is a collateral major (some of the required courses satisfy GER as noted on this table) See School of Education.
<b>Accelerated bachelor's/master's degrees in biological sciences</b>					
BA/MA in Biological Sciences with specialization in Biotechnology	Five-year program. Begin graduate work as seniors and receive the MA one year after completing BA requirements. Successful completion of the biotechnology workshop (BIOL 410/610), entitles students to a summer internship in an industrial or private research laboratory. Interested biology majors should contact a departmental adviser as early as possible.				
BA/MS in Biological Sciences/Environmental and Occupational Health	Opportunity for biology majors to have a career option in public health. Consult a departmental adviser as well as the office of the Director of the Environmental and Occupational Health Sciences Program at the Brookdale Campus, early in undergraduate studies.				
BS/MA in Medical Laboratory Sciences with specialization in Biotechnology	Qualified seniors majoring in medical laboratory sciences (see p. 211) may apply to the BS/MA collaboration between MLS and biological sciences. An intensive techniques workshop (BIOL 410) is taken prior to graduation and upon successful completion, students may continue with professional internship, and MA program, allowing MLS graduates to complete the degree at an accelerated pace.				

The Department of Biological Sciences at Hunter College stresses excellence in both teaching and research. Fully equipped research laboratories are supported by major federal grants and students are strongly encouraged to become involved in laboratory research. State-of-the-art flow cytometry and bioimaging facilities are housed within the department. They have been created and are funded by federal grants, New York State and the Center for Gene Structure and Function. The Center consists of faculty from the Departments of Biological Sciences, Chemistry, Physics, Psychology and Anthropology working in the areas of biomolecular structure and function.

The core curriculum in biological sciences prepares students for admission to both graduate and medical schools and for careers in the biological sciences, including teaching and the growing industry of biotechnology. The curriculum emphasizes cell biology, molecular biology, developmental biology, genetics and neurobiology as the foundation for future careers in fields related to the biological sciences.

## Career Planning

**Graduate Study** The department offers a master of arts in the biological sciences and courses taken in the MA program can later be credited toward the PhD upon acceptance into the CUNY doctoral program in biology. Interested students should obtain the Hunter College Graduate Catalog and contact the biology master's program adviser. Laboratory research under faculty supervision (see undergraduate research, below) is extremely valuable for gaining admission to graduate schools. Students planning to apply to graduate school should consult with their adviser as early in their college career as possible.

**Professional Schools** Students who plan to apply to schools of medicine, dentistry, or veterinary medicine should consult with their adviser and see the preprofessional adviser in 812 Hunter East.

**Preparation for Teaching** In cooperation with the School of Education, the Department of Biological Sciences offers opportunities for students to prepare for a teaching career in elementary and secondary schools. Major I in biology satisfies the requirements for New York State certification of at least 30 credits for teachers in adolescence education, grades 7-12. Major II in biology satisfies the requirements for New York State certification for teachers in childhood education, grades 1-6 (see below). See the School of

Education section of this catalog and consult with an adviser in the School of Education for additional information and requirements.

**Preparation for Biotechnology** Students interested in careers in the rapidly growing field of biotechnology should select Major I and consult with their adviser as early as possible. Advanced courses taken as electives should include BIOL 410 and those special topics courses (BIOL 470-471) that are most relevant to biotechnology.

Qualified students are also encouraged to pursue the BA/MA Program in Biotechnology (see below).

## MAJORING IN THE BIOLOGICAL SCIENCES

The Department of Biological Sciences offers two major programs. Major I is for students who intend to prepare for graduate study, medicine, dentistry, secondary school teaching, biotechnology and industry. Major II is for students preparing to teach in elementary schools. Students planning to pursue Major I are strongly encouraged to declare their major as soon as possible after completing one semester of Principles of Biology. Declared majors are assigned a permanent faculty adviser who will assist in individual curriculum planning. Students are required to meet with their adviser at least once each semester throughout their undergraduate career to discuss their program and progress.

### MAJOR I

This plan consists of 9 credits of introductory biology (BIOL 100-102) and a 28-credit concentration in biology at the 200-level and higher. The biology concentration consists of an 18-credit core—BIOL 200, 202, 300, 302—and 10 credits of electives. Together, introductory biology and the concentration (37 cr) satisfy the major requirement for certification as a teacher of biology in grades 7-12.

Additional science and math requirements for Major I: CHEM 102, 103, 104, 105, 222, 223, 224; PHYS 110, 120 (or 111, 121); MATH 150; MATH 155 or STAT 213.

#### Electives (10 cr)

Students may select the remainder of their credits toward Major I from advanced courses in the biological sciences. At least one course must be at the 300 level, in addition to BIOL 300 and 302. At least one special-topics course must also be taken (BIOL 470 or 471; various topics offered each semester). Students with strong interdisciplinary interests may select advanced course offerings in other departments or SCI 302 (an interdisciplinary course), after approval by their adviser.

### Minor for Major I

12 credits in a field approved by faculty adviser. Note that although other minors may be taken, chemistry is the usual minor, as the required courses CHEM 102-105 and 222-224 fulfill the minor requirements. For students preparing to teach biology at the secondary school level, adolescence education is an appropriate minor (see the School of Education section of this catalog). Minor courses can be used without limit to satisfy Stage 1, 2 and 3 of the GER core.

#### Curriculum Guide for Major I

FALL	SPRING
<b>Year 1</b>	
BIOL 100	BIOL 102
*CHEM 102, 103	*CHEM 104,105
<b>Year 2</b>	
BIOL 200	BIOL 202
*CHEM 222, 223	*CHEM 224
*MATH 150	*MATH 155 or STAT 213
<b>Year 3</b>	
BIOL 300	BIOL 302
*PHYS 110 or 111	*PHYS 120 or 121
BIOL electives (300 level)	BIOL electives (300 and 400 level)
<b>Year 4</b>	
BIOL electives (300 & 400 level)	BIOL electives (300 and 400 level)

\*We recommend that math, physics and chemistry courses be completed as early as the student's schedule allows. Note that CHEM 224 must be taken prior to or corequisite with BIOL 300; otherwise, instructor permission is required. Students who are behind in the chemistry sequence are urged to take advantage of the summer session, during which these chemistry courses are usually offered.

### MAJOR II

(for students planning to teach in childhood education, grades 1-6)

This plan consists of 26 credits in biological science, 12 credits in additional science and 6 credits in math. Major II satisfies the major requirements for certification as a teacher for grades 1-6. This major requires 30 credits of education courses and should thus be initiated as early as possible.

- A. BIOL 100, 102 .....(9 cr)
- B. Courses approved by adviser selected from the 200 or 300 level .....(17 cr)

### Minor for Major II

Childhood education (grades 1-6) is a collateral major and thus students are exempt from having a minor. See the School of Education section of this catalog for requirements.

Additional science and math requirements for Major II: CHEM 100, 101, 120, 121; PHYS 101 (or PHYS 110 or 120); MATH 104 and 105.

#### Curriculum Guide for Major II

FALL	SPRING
<b>Year 1</b>	
BIOL 100	BIOL 102
CHEM 100, 101	CHEM 120, 121
<b>Year 2</b>	
BIOL electives	BIOL electives
PHYS 101(or 110 or120)	MATH 105
MATH 104	
EDUC course(s)	EDUC course(s)
<b>Year 3 and 4</b>	
BIOL electives	BIOL electives
EDUC course(s)	EDUC course(s)

### CR/NC Policy

Only a letter grade (A, B, C, D, including + or -) will be accepted by the department in the required science and mathematics courses for the biology Major I and Major II.

### Minor for other Majors

For the biology minor, the department recommends at least two courses beyond the required BIOL 100, 102 (GER 2E) at the 200 level or above. Please note that the major department must approve the minor.

### Opportunities for Undergraduates in Biological Sciences

**Undergraduate Research** Students who wish to undertake a research project under the supervision of a faculty member must first obtain written permission from that faculty member and then register for BIOL 480-483. Research opportunities for undergraduates at Hunter are available in cell and molecular biology, developmental biology, neuroscience, cancer biology, AIDS, microbiology and a variety of other contemporary areas. In some cases students may be permitted to work at one of the several neighboring research institutions. Synopses of faculty research interests can be obtained in the department office or from the Department of Biological Sciences Web site (<http://sonhouse.hunter.cuny.edu/>). Please note that, to qualify for departmental honors at graduation, there is a research requirement (see below).



## Honors Work

In order to qualify for departmental honors, students must have a departmental GPA of at least 3.5 and an overall GPA of at least 2.8. They must also satisfy a research requirement consisting of either: (a) at least 2 credits of BIOL 480-483; or (b) at least one course chosen from among BIOL 375, 390, or 410. The research requirement includes a written report resulting from work in any of these courses.

## BA/MA Program with Specialization in Biotechnology

In this five-year program, qualified biology majors begin graduate work as seniors and receive the MA one year after completing BA requirements. Students are provided with theoretical knowledge and skills in molecular biology and a foundation for application of these skills in careers in the biotechnology and pharmaceutical industries, academic research, or public health. Successful completion of the biotechnology workshop (BIOL 410/610), an essential program component, entitles students to a summer internship in an industrial or private research laboratory. Interested biology majors should contact a departmental adviser as early as possible.

## BA/MS Program in Biological Sciences/Environmental and Occupational Health Sciences

This is an accelerated program leading to a BA in biology and an MS in environmental and occupational health sciences in five years. Biology majors admitted to the program start graduate work in their senior year. Interested students should contact a departmental adviser early in their undergraduate studies, as well as the office of the Director of the Environmental and Occupational Health Sciences Program at the Brookdale Campus. The program provides biology majors with a career option in public health.

## BS/MA Program in Medical Laboratory Sciences and Biotechnology

See the Medical Laboratory Sciences section of this book.

## BA/MA Program in Biological Sciences and Adolescence Education: Biology

This is an accelerated program leading to a BA in Biological Sciences and an MA in Adolescence Education: Biology. Undergraduates admitted to the program start graduate courses during their senior year and will be able to complete the MA degree one year after they complete the requirements for the BA degree. Interested students should contact a Biology Department adviser early in their undergraduate career.

## MA Program in Biological Sciences

See Career Planning-Graduate Study above.

## COURSE LISTINGS

### BIOL 100 Principles of Biology I

GER 2/E PD/C or D

The chemical basis of life; basic structure and function of pro- and eucaryotic cells; bioenergetics; Mendelian and molecular genetics; development and mechanisms of control of gene expression at all levels; population genetics and evolution. \$5 materials fee required. PD credit awarded only upon completion of BIOL 100 and 102.

*prereq:* MATH 101 or equivalent  
7 hrs (3 lec, 3 lab, 1 disc), 4.5 cr.  
fall only

### BIOL 102 Principles of Biology II

GER 2/E PD/C or D

Taxonomy; homeostasis; internal transport and gas exchange in plants and animals; plant hormones; osmoregulation; mechanisms of action in the muscular, nervous and neuroendocrine systems; the senses, behavior; ecology. \$5 materials fee required. PD credit awarded only upon completion of BIOL 100 and 102.

*prereqs:* BIOL 100 or perm instr, MATH 101 or equiv.  
7 hrs (3 lec, 3 lab, 1 disc), 4.5 cr.  
spring only

### BIOL 120 Anatomy and Physiology I

Cell structure and function; histology; nervous, muscular and skeletal systems; integument. Required for admission to the nursing program. Not accepted for credit toward the biology major.

*prereqs:* CHEM 100, 101  
*coreqs:* CHEM 120, 121  
6 hrs (3 lec, 3 lab), 4.5 cr.  
fall only

### BIOL 122 Anatomy and Physiology II

Structure and function of circulatory, digestive, excretory, endocrine and reproductive systems. Basic concepts of metabolism, embryology. Required for admission to the nursing program. Not accepted for credit toward the biology major.

*prereq:* BIOL 120 or equiv.  
6 hrs (3 lec, 3 lab), 4.5 cr.  
spring only

### BIOL 160 Honors Principles of Biology II

GER 2/E PD/C or D

Enrollment limited. Physiological systems and their regulation: internal transport, hormones and gas exchange in plants and animals; osmoregulation; motility; nervous, neuroendocrine, immunological and sensory systems; behavior, reproduction and ecology. Students will read reviews of current research in addition to the required text. Guest speakers and class presentations. Core credit awarded only if BIOL 100 and 160 are both completed. PD credit awarded only upon completion of BIOL 100 and 160.

*prereqs:* grade of B or better in BIOL 100 or perm instr, MATH 101 or equiv.  
7 hrs (3 lec, 3 lab, 1 disc), 4.5 cr.  
spring only

### BIOL 200 Cell Biology I: Microorganisms

GER 3/B

Structure and function of procaryotic cells and viruses; cultivation, growth, evolution, metabolism and genetics of microorganisms. Laboratories include light microscopy techniques, cultivation, growth, metabolism and genetics of microorganisms and viruses. \$10 materials fee required.

*prereqs:* BIOL 100 and 102 or equiv; CHEM 102, 103, 104, 105 or equiv.  
*coreqs:* CHEM 222, 223 or perm instr.  
(for Major II students, chem prereqs are CHEM 100, 101; coreqs are 120,121)  
7 hrs (3 lec, 3 lab, 1 disc), 4.5 cr.  
fall only

### BIOL 202 Cell Biology II: Eucaryotic Systems

GER 3/B

Structure and function of eucaryotic cells and organelles; membrane systems, cell cycle, cell division, signaling, cytoskeletal systems, motility; specialized cells; modern research tools and approaches. Laboratories include plant and animal cell culture; studies of cell division, the cytoskeleton, motility; light and electron microscopic methods; fluorescence labeling; protein electrophoresis, immunoblotting and immunolocalization. \$10 materials fee required.

*prereq:* BIOL 200  
*coreq:* CHEM 224 or perm instr.  
7 hrs (3 lec, 3 lab, 1 disc), 4.5 cr.  
spring only

### BIOL 230 Fundamentals of Microbiology

GER 3/B

Topics include scope, historical aspects, taxonomy, survey of the microbial world, viruses, infectious diseases, control of microorganisms and immunology. Required for admission to the nursing program. Not accepted for credit toward the biology Major I.

*prereqs:* CHEM 100, 101, 120, 121 or equiv; BIOL 120  
*coreq:* BIOL 122  
5 hrs (2 lec, 3 lab), 3 cr.  
spring only

### BIOL 250(W) Current Topics in the Biosciences

GER 3/B

Seminar for non-science majors focusing on topics of current relevance such as the science of emerging diseases, bioterrorism, genetic engineering, stem cell research and global warming. Coverage includes the social, legal, political and ethical issues associated with each topic. Not accepted for credit toward biology Major I.

*pre- or coreq:* ENGL 120 or equiv, 2 sems intro lab science or equiv, or perm instr.  
3 hrs 3 cr.  
fall only

### BIOL 280 Biochemistry of Health and Nutrition

GER 3/B

Basic biochemistry in areas related to human health and nutrition. Designed for students in the dietetics program. (Not accepted for credit toward biology Major I.)

*prereqs:* BIOL 100, 102 or 120, 122; CHEM 100, 120  
3 hrs (lec), 3 cr.  
fall only

**BIOL 300 Biological Chemistry**

GER 3/B

Molecular aspects of cellular function; properties of biomolecules, their biosynthesis and breakdown; structure and function of proteins and enzymes, metabolites, membranes and nucleic acids; cellular mechanisms of energy transduction; integration and control of cell metabolism. Experiments cover a variety of modern techniques in molecular biology. \$10 materials fee required.

*prereqs:* BIOL 202, CHEM 222, 223

*coreq:* CHEM 224

7 hrs (3 lec, 3 lab, 1 disc), 4.5 cr.

fall only

**BIOL 302 Molecular Genetics**

GER 3/B

A comparison of viral, procaryotic and eukaryotic systems; review of classical Mendelian principles; bacterial DNA replication, transcription and their control; mechanisms of gene mutation, repair, recombination and transposition; applications of recombinant DNA technology; organization of nucleic acid into chromosomes; control of gene expression, the cell cycle and cell development in eucaryotes. \$10 materials fee required.

*prereq:* BIOL 300

7 hrs (3 lec, 3 lab, 1 disc), 4.5 cr.

spring only

**BIOL 304 Environmental Microbiology**

GER 3/B

Role of microorganisms in normal and polluted environments: bioremediation, waste and water treatment, heavy metals, nutrient cycles, microbes as a food source, algal toxins, microbial pesticides, microbial indicators of mutagens and pollutants, microbial leaching of ores.

*prereq:* BIOL 100, 102, 200 or perm instr.

3 hrs (lec), 3 cr.

spring alternate years

**BIOL 306 Developmental Biology**

GER 3/B

Major topics include molecular and cellular mechanisms of early embryonic development in amphibians, mammals and model organisms such as *Drosophila*, as well as the related subjects of vertebrate organ system development, biology of stem cells and animal cloning. Emphasis is placed on seminal and current research in cell-cell communication, signal transduction and differential gene regulation in developmental processes.

*prereq:* BIOL 300

3 hrs (lec), 3 cr.

fall only

**BIOL 322 Evolution**

GER 3/B

Modern synthetic theory, genetic basis of variation, gene pool in populations.

*prereq:* BIOL 300

3 hrs (lec), 3 cr.

**BIOL 350 Regulation of Cell Proliferation**

GER 3/B

Control of cell division examined in the context of cancer, which is the loss of this control. Topics include: cell culture, the cell cycle, hormones, receptors, intracellular signal transduction, oncogenes, tumor suppressor genes and the etiology of human cancer.

*prereq:* BIOL 202, 300, or perm instr.

3 hrs (lec), 3 cr.

spring alternate years

**BIOL 360 Cellular and Molecular Immunology**

GER 3/B

Study of the immune system from a molecular perspective. Molecular genetics of antibody and T cell receptor diversity, hematopoiesis and lymphocyte development, humoral and cellular immunity, histocompatibility.

*pre- or coreq:* BIOL 300, perm instr.

4 hrs (3 lec, 1 disc), 3.5 cr.

fall only

**BIOL 370 Physiology of the Nervous System**

GER 3/B

A comprehensive introduction to neuroscience. Topics include how nerve cells (neurons) transmit electrical impulses, how neurons communicate with each other through synapses and how nerve pathways and networks determine many functions of the brain. The last portion of the course shall explore how developing neurons seek out targets and establish synapses.

*prereq:* BIOL 300 or perm instr.

4 hrs (lec), 4 cr.

spring only

**BIOL 375 Molecular Systematics**

GER 3/B

An overview of the various methods and kinds of data used in systematics, the study of organism diversity and biological relationships. Emphasis is on modern molecular and genetic approaches to identification of individual species and strains and full phylogenetic analyses of suites of species to determine their evolutionary history. The knowledge base is provided for experimental investigation of questions of current interest in phylogeny and population biology.

*prereq:* BIOL 300 or perm instr.

3 hrs, 3 cr.

**BIOL 376 Endocrinology**

GER 3/B

Cellular organization of the endocrine system; molecular mechanisms of hormone action; hormonal physiology of metabolism and reproduction; integration of endocrine responses by the central nervous system.

*prereq:* BIOL 202 or perm instr.

3 hrs (lec), 3 cr.

spring only

**BIOL 380 Molecular Neurobiology**

GER 3/B

Molecular components and molecular mechanisms involved in the cell biology of neurons and glia, neuronal signaling, neuronal development, learning, memory and diseases of the nervous system.

*prereq:* BIOL 300 or perm instr.

3 lec hrs, 3 cr.

fall alternate years

**BIOL 390 Laboratory in Cell Structure**

GER 3/B

Applications of light and electron microscopy to study of cell structure and function. Lab projects utilize thin sectioning, negative staining, scanning, darkroom printing, digital imaging and other techniques.

*pre- or coreq:* BIOL 300 or BIOL 202 and perm instr.

5 hrs (1 lect/demo, 4 lab), 3 cr.

fall only

**BIOL 400 Special Topics in Advanced Laboratory Techniques**

GER 3/B

Advanced laboratory techniques used in contemporary biological research, including areas such as immunology, microbiology and molecular neurobiology. Topics change from term to term.

*prereq:* BIOL 300 or perm instr.

4 hrs (lab), 2 cr.

**BIOL 410 Workshop in Biotechnology**

GER 3/B

A series of laboratory-intensive experimental projects, each lasting one week or more, which introduce current research techniques and include individual participation in planning and preparation of experiments. The focus is on a broad biotechnology topic such as the isolation, cloning and expression of a gene, utilizing the techniques of molecular genetics. This course satisfies the research requirement for graduation with departmental honors and is a component of the interdisciplinary BS/MA (MLS/Biol) program in biotechnology.

*prereqs:* BIOL 200, 202, perm instr.

30 hrs/week for 4 weeks, 4 cr.

**BIOL 450 Individual Tutorial in Biology**

GER 3/B

May be taken only once. Research paper written under the direction of a full-time faculty member in department of biological sciences.

*prereqs:* 18 cr in biology, approval of adviser in addition to the sponsor

1-2 cr.

**BIOL 460 Introduction to Planning and Teaching of Laboratory Work in Biology**

GER 3/B

Participation in discussions and assisting in the teaching of laboratories in an introductory course, or peer mentoring in the undergraduate biological sciences research techniques facility.

*prereqs:* 16 cr in BIOL, 12 cr in CHEM, 2 letters from faculty required

5 hrs (2 planning, 3 lab), 2 cr.

**BIOL 470, 471 Special Topics in Biology**

GER 3/B

Specific area of contemporary interest in biology. Topics change from term to term. An oral presentation and a written paper are required.

*prereq:* BIOL 300

2 hrs (lec), 2 cr. per sem.

**BIOL 480-483 Introduction to Experimental Biology**

GER 3/B

Laboratory research under guidance of faculty member. Work at another institution may be permitted in some cases, under auspices of a faculty member. Written report required upon completion of research. A minimum of 2 credits satisfies the research requirement for graduation with departmental honors.

*prereqs:* BIOL 100 and 102, BIOL 200 or 202 (or the equiv), written perm instr. prior to reg. hrs TBA, 1-2 cr. per sem.

**Courses Not Offered in 2004-2007****BIOL 208 Ecology****BIOL 220 Topics in Genetics and Evolution****BIOL 252 Comparative Anatomy of the Vertebrates****BIOL 335 Comparative Animal Physiology****BIOL 340 Plant Physiology**