

Find the Biology Curricula on the Web at

<http://biology.syr.edu/undergrad/programs.html>

BIOLOGY DEPARTMENT MAJORS UNDERGRADUATE CURRICULA

BS Degree in Biology

BS Degree in Biology with Focus on Environmental Sciences

BA Degree in Biology

BS Degree in Biochemistry

BS Degree in Biotechnology

Minor in Biology

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I. The Biology Department Undergraduate Office

All undergraduate programs are administered through the Undergraduate Programs Secretary, Ms. Deborah Herholtz. She is located in **Room 114** in the **Life Sciences Complex (LSC) Biology Department Office** (telephone: 443-9139; e-mail: herholtz@syr.edu).

II. Academic Advising and Degree Programs for Biology Majors.

Declaring a Major in Biology and Obtaining a Faculty Advisor.

Biology Majors (BA or BS Degrees): All incoming freshman or transfer students who have an interest in a Biology major should seek to declare the major as early as they are able to meet the following declaration requirements.

To declare the B.S. major in Biology (or the B.A. in Biology, or the B.S. in Biotechnology) students must:

1) earn a C+ or better in a General Biology course (BIO 121 or BIO 123 or accepted AP);

- AND -

2) either earn a C+ in one of the four 300-level core courses (BIO 305, BIO 326, BIO 327, BIO 345) or have a 3.0 cumulative GPA any time after the first semester.

If you meet the above requirements, you may bring a completed **Declaration of Major** form along with a current unofficial copy of your transcript (available on **MySlice**) to the Biology Department Undergraduate Secretary, Deb Herholtz (LSC 114, 315-443-9139, herholtz@syr.edu), who will then assign you a Biology or Biotechnology advisor.

If you have an advisor in another department but you wish advice about a Biology major, contact the Biology Department Principal Advisor, Dr. Melissa Pepling (LSC 348, 315-443-4541, mepeplin@syr.edu).

Pre-Health Professions Students: You do not need to major in Biology to prepare for admission to health professional schools. These schools generally require specific courses in math, chemistry, physics and biology to be part of their applicants' undergraduate curricula. Many of these requirements are similar to requirements for the BS Degrees in Biology, Biochemistry and Biotechnology. If you are interested in a health profession, you should seek advice through the Health Professions Advisory Program (see below).

III. Biology Degree Programs

The Biology Department currently offers courses leading to six possible degree options: B.S. – Biology; B.A. – Biology; B.S. – Biochemistry; B.S. – Biotechnology; B.S. – Biology with Focus in Environmental Sciences; and a Minor in Biology. Short descriptions of each of these degrees and careers for which they are intended to provide preparation can be found on the next page. Summaries of each degree program's requirements can be found in the later pages of this booklet. Which degree option is the best choice for you will be determined by you based on your eventual career interests and experience as you undertake courses in specific areas of the life sciences. Your interests and degree plans may well evolve during your time as an undergraduate student, however it is important to remember that to graduate with a degree in Biology you must satisfy all of the requirements of at least one of the degree programs. There are many possible ways to satisfy these requirements and

students are encouraged to discuss how specific courses (in Biology or other related disciplines) can function to meet the degree requirements. Your advisor in Biology can assist you in planning your specific program of study. You may request an advisor in the area you select. To do this, see Deborah Herholtz in 114 LSC.

Many Biology courses and our majors can also help fulfill the Biophysical Sciences degree offered jointly by Physics and Biology, and the College's new Interdisciplinary Learning Majors (ILMs) in Ethics, Energy and Its Impacts, Forensics and Neurosciences. Students interested in these programs are encouraged to contact the College of Arts and Sciences Academic Advising program for additional information on them.

Biology Degree Programs

Biology - Bachelor of Science (BS) Degree is designed for students who wish to pursue graduate professional degrees in biology, biotechnology or in the health professions. This degree program is intended to expose students to the breadth of topics relevant to careers in today's life sciences professions. After introductory biology, students will complete four Core Courses, one of which is an Integrative Laboratory meant to build laboratory skills and help demonstrate the increasingly inter-disciplinary nature of efforts to understand biological phenomena. In addition to the Core Courses, students will complete 22 credits of additional upper division courses and laboratories (minimum of 6 credits). At least 3 credits (generally one course) of upper division coursework must satisfy a Distribution Requirement such that a minimum of 3 credit hours of coursework are taken from each list of courses in the areas of A) cell and molecular biology and B) ecology and evolution. The purpose of this requirement is to assure adequate breadth of advanced knowledge in biology which may be relevant to students' future careers in the life sciences. Finally, one upper division course must satisfy the Communication Skills requirement.

Biology - Bachelor of Arts (BA) Degree is designed for students who wish to pursue science related careers outside biology and for whom some background in science may be useful, such as science journalism, science teaching, business, or law.

Biochemistry - Bachelor of Science (BS) Degree is designed to prepare students for pursuing advanced degrees in biochemistry, molecular biology, and biophysics as well as in the biomedical fields and health professions. Biochemistry is the study of the molecular basis of life. Lying at the interface between chemistry and biology, biochemistry is concerned with the structure and interaction of proteins, nucleic acids, and other biomolecules as related to their function in biological systems. As one of the most dynamic areas of science, biochemistry has led to improved medicines and diagnostic agents, new ways of controlling disease, and greater understanding of the chemical factors that control our general health and well-being. Before declaring the biochemistry major, students must earn at least 30 credits in courses graded A-F at Syracuse, and earn at least a grade of C+ in CHE 275 and BIO 326 or 327. This course is co-administered through the Biology and Chemistry Departments at Syracuse University and more information can be found at the program web site <http://biochem.syr.edu>.

Biotechnology - Bachelor of Science (BS) Degree program offers students an opportunity to take courses in biology, environmental sciences, chemistry, engineering, law, management and public policy important for addressing biotechnology-related issues. This program will help students to prepare for jobs in areas such as the biotech industry, health professions, pharmaceutical industry and research in academia. The program requires the same basic courses as the B.S. degree in Biology with substitution of elective courses in engineering, law, management and public policy. A senior year capstone class (Biotechnology Seminar) and internship/independent research is required.

Biology - Bachelor of Science (BS) Degree with Focus on Environmental Science offers students an opportunity to receive a rigorous and broadly based foundation in the environmental sciences to address today's critical environmental problems. The program requires the same basic courses as the BS degree in Biology with a concentration in ecology and evolution, with an option to take courses in earth science, biology, geography or engineering to satisfy upper division requirements. Students in this program are advised by Dr. Doug Frank (446 LSC; dafrank@syr.edu).

Minor in Biology is designed for students who wish to augment other majors such as psychology, engineering, chemistry, physics, writing or illustration with a biological component.

IV. Additional Resources available to Students in Biology and the College

A. Other Degree Programs with Course Content from Biology

i. **Biophysical Sciences B.A. degree**

Co-administered with the Physics Department.

http://asacademics.syr.edu/Biophysical/requirements_biophysical.html

Contact Liviu Movileanu (lmovilea@syr.edu) for more information.

ii. **Integrated Learning Majors (ILMs)**

Currently there are four ILMs in which Biology participates.

Information on degree requirements for these ILMs can be found at:

Ethics http://asacademics.syr.edu/ethics-ILM/requirements_ethics.html

Energy and Its Impacts http://asacademics.syr.edu/energyimpact/requirements_energyimpact.html

Forensic Science <http://forensics.syr.edu/ugrad-ILM.html>

Neuroscience http://asacademics.syr.edu/neuroscience/requirements_neuroscience.html

B. Career Advising

The following are some programs in career areas of interest to many Biology Majors.

Health Professions Advising: Students interested in any of the health professions should make an appointment with the Health Professions Advising office (HPA), Hall of Languages room 323, 443-2321 as soon as possible, and see <http://hpap.syr.edu>. When you complete an application for sponsorship by HPA in your sophomore year, you will be assigned a pre-professional advisor. From then on you will have two advisors: an academic advisor in the Biology Department, and a health professions advisor to help you prepare credentials for application to a health professions school.

Graduate Programs in Biology (M.S., Ph.D.): Students interested in a graduate degree in biology should obtain advice on selecting and applying to graduate schools no later than the end of their junior year. A Biology academic advisor or other Biology faculty in the areas of your interests for advanced study can give you advice on different schools, letters of recommendation, the Graduate Record Examinations, etc.

Teaching: Students interested in science teaching may wish to consider a dual major with the Biology Department and the Department of Science Teaching located in Heroy Hall, room 101, 443-2586. This should be done no later than the end of the sophomore year.

V. Undergraduate Research in Biology.

As an important part of scientific scholarship in action, the Biology Department offers its undergraduates opportunities to participate in research. If you are interested in the possibility of doing research, we urge you to obtain the special booklet, "**Undergraduate Research Opportunities for Biology Majors**," in the Biology Office, room 114 LSC. You also can find information on our web site at: <http://biology.syr.edu/undergrad/research.html>.

Undergraduate research is important for anyone interested in graduate study in Biology. This is because most graduate work involves doing research. An application for graduate school can be greatly enhanced if you can demonstrate an interest in and an ability to do research.

Undergraduate research requires you to find a faculty member or mentor who will guide your research. Research mentors can be members of the Biology faculty or other departments at SU (e.g. Chemistry, Physics, Bioengineering), or at SUNY Upstate Medical University or SUNY ESF. Research can begin as early as your first year. Credit for research can be obtained by registering for BIO 460, Research in Biology, which requires completion of a Petition for BIO 460 available in room 114 LSC. Research also can be done through the Distinction/Honors Program, which is coordinated in Biology by Dr. Kari Segraves, room 438 LSC.

We encourage all biology majors to participate in research, but it must be emphasized that available space with faculty is limited, and **the primary responsibility for initiating participation resides with you**. A list of Biology faculty who sponsor undergraduate research is given in the booklet, **Undergraduate Research Opportunities for Biology Majors**, mentioned above <http://biology.syr.edu/undergrad/research.html>. Also, Deborah Herholtz (room 114 LSC) has a list of potential research sponsors in other departments at SU, at SUNY Upstate Medical University and at SUNY ESF.

Biology Program Degrees and Degree Requirements

Sample Schedule -Biology B.S. degree – for students matriculating in 2010 and after

	<u>Fall</u>	<u>Spring</u>
Freshman	Bio 121 Chem 106/107 Mat 285 or 295	Bio 326 Chem 116/117 Mat 286 or 296
Sophomore	Bio 327 Chem 275/276	Bio 305
Junior	Bio 345** 3 credit lecture*	3 credit lecture* 3 credit lab*
Senior	3 credit lecture* 4 credit lecture with lab*	3 credit lecture* 3 credit lab*

*Need to take 22 upper division credits (courses that are 300 or higher) (must take at least 3 credits in the area of Cell and Molecular Biology and 3 credits in Ecology and Evolution). 6 of these credits need to be lab credits, the rest lecture courses. These are typically taken during the junior and senior years but can be taken in any order and one example of this is shown.

**Bio 345 is required for the B.S. degree and may be taken at any time. Students are strongly encouraged to take it in their Sophomore year if their schedules allow, but should take it no later than Fall of their Junior year as it and Bio 305 must be in progress or completed for scheduling preference for upper division laboratories.

***Only courses required for the Biology B.S. major are shown. Students seeking Biochemistry and Biotechnology degrees will have similar scheduling through the end of the Sophomore year and will then undertake electives and core courses specific to these programs. Premedical and some health professions students will want to consider taking a second semester of Organic Chemistry with laboratory, Che 325/326 in the Spring of the Sophomore year and a sequence of Physics with lab, usually in the Junior year. The rest of the schedule is filled with courses that fulfill the Liberal Arts Core or with electives. 15 credits are usually taken each semester (as 120 total credits are needed to graduate).

2010 - Biology – B.S. Degree Requirements (57 to 59 total credit hours)

Introductory Biology:

Minimum of 4 credits with 1 credit being laboratory

BIO 121 - General Biology I (4)

- BIO 121 is a four-credit course, which includes one credit of laboratory, and is required of majors who do not have AP credit. Majors are no longer expected or required to take BIO 123 and 124 (General Biology II Lecture (123) and Laboratory (124), but may do so if they so desire.
- Students with 4 to 8 credits of Advanced Placement may elect to omit the General Biology introductory courses. If you have AP credit, but take the course, you will lose the AP credit.
- Pre-health professional students who do not intend to major in biology are strongly advised to take BIO 123 and 124, subsequent to taking BIO 121; these courses fulfill professional school requirements of one year of general biology with laboratory.
- Pre-health professional students with AP credit and who major in biology are able to opt out of taking General Biology as they will have other, more advanced biology laboratory courses that will fulfill requirements of health professions schools.

Core Courses in Biology*:

BIO 305 – Integrative Biology Laboratory	(Spring)	(3) (any 2 of 326, 327, 345 prereq)
BIO 326 – Genetics	(Spring)	(3)
BIO 327 – Cell Biology	(Fall)	(3)
BIO 345 – Ecology and Evolution	(Fall)	(3)

*Note that as of 2012, students must achieve a C+ or better in at least one core course, plus BIO 121, 123 or equivalent, prior to being allowed to declare the Biology major.

Intro + Core

Total credits = 16

Upper Division Courses in Biology:

Total credits = 22

Students should select additional upper division courses (numbered 300 or above) totaling at least 22 credits. As detailed on the following pages, these credits should include six credits of laboratory courses and a communications skills course. Some lab courses also fulfill the communications skills requirement. Finally, the 22 credits of upper division coursework must satisfy a distribution requirement such that a minimum of 3 credit hours of coursework are taken from each list of courses on the following page.

Total Minimum Number of Biology Credits Required = 38

Non-departmental B.S. Degree Requirements = 19 – 21

Chemistry:	CHE 106/107 – General Chemistry I with lab	(4)
	CHE 116/117 – General Chemistry II with lab	(4)
	CHE 275/276 – Organic Chemistry I with lab	(5)
Mathematics:	Either MAT 285/286 – Calculus I and II*	(6)
	Or MAT 295/296 – Calculus I and II*	(8)
	Or MAT 295 and APM 391 (ESF course)	(7)

*Either calculus sequence fulfills the Liberal Arts Core quantitative skills requirement, but MAT 295/296 is pre-requisite for Calculus III and other higher-level mathematics courses.

Upper Division Biology Courses – Distribution Requirement for the B.S. degree

At least 3 of the 22 Upper Division Credits must be from each list). L- denotes a laboratory course (# of credits counted as lab in parentheses). Underlined courses fulfill the Communication Skills Requirement

Cell and Molecular Biology

300 – Dance, Exercise and Brain Function
300 – Research Methods for Life Scientists
316/317 L (3) - Anatomy and Phys. I&II*
355 - General Physiology
396/REL 359 – Stem Cells & Society
400 – Brain and Behavioral Plasticity
400 - Experimental Designs & Interpretations in Biol
400 – Food for Thought: Brain Bioenergetics
400 - Neurochemistry of Memory
400 – Nervous System Insult
400 – Seminar in Neurodegenerative Disease
400 – Principles of Toxicology
400 – Quantitative Methods for Life Scientists
400 – Rhythms of the Brain
400 – Sem: Epigenetics of Human Health & Disease
400 – Seminar in Cell Biology & the Cytoskeleton
407- Advanced Neuroscience
409 L (1) - General Microbiology**
414 – Biology of Adaptive Behaviors
416 – Biology of Aging
421 – Capstone Seminar in Biotechnology
422 L- (3) Bioinformatics for Life Scientists
425 L- (3) Cell and Developmental Biol. lab
435 L- (3) Genetics lab
437 – Seminar in Develop. Neuro. (Bio 400)
441 – Seminar in Infectious Diseases (Bio 300)
442– Seminar in Model Organism Genetics (Bio 400)
443 – Seminar in Epigenetics (Bio 400)
444 – Seminar in Neurotoxicology (Bio 400)
447- Basic Immunology
457 – Principles of Human Toxicology (Bio 400)
459 – Plants & People (Bio 300)
462- Molecular Genetics
463 L- (3) Molecular Biotechnology*
464 L- (3) Applied Biotechnology*
465 L- (3) Molecular Biology Lab
469 – Countering Weapons Mass of Destruction
472 L (3) – Advanced Light Microscopy (Bio 400)
475 L- (4) Biochemistry lab
496 – Neuroscience and Society (Bio 400)

501- Biology of Cancer
503- Developmental Biology
565 - Cell Physiology
BCM 475 - Biochem I
BCM 476 - Biochem II
BIO 575/576- Biochem I & II (previous numbers)

Ecology and Evolutionary Biology

310 – Evolution, Religion and Society
312/313 – Marine Ecology of Spain
400 – Biology of Marine Mammals
400 – Biomimicry
400 – Comparing Sperm and Pollen Evolution
400 L – (3) Ecosystem Ecology Laboratory
400 - Evolutionary Genetics of Complex Traits
400 – Global Change Biology
400 L – (3) Global Change Ecology Laboratory
400 – Isotopic Approaches in Global Change Eco
400 – Quantitative Methods for Life Scientists
400 – Seminar in Molecular Ecology
400 – Seminar in Disturbance Ecology
400 – Seminar in Ecosystem Science
400 – Sexual Selection
400 – Sexual Selection and Mating Strategies
400 – Species Interactions and Biodiversity
400 – Topics in Evolution
405 L – (3) Introduction to Field Biology (lab)
411 – Evolutionary Mechanisms (Bio 400)
415 - Conservation Biology
417 L- (3) Animal Behavior & Evolutionary Bio Lab
428 – Capstone Seminar - Environmental Science
431- Population Genetics
439 – Seminar in Ecosystem Ecology (Bio 400)
448- Evolutionary Medicine
450 – Seminar in Evolutionary Genetics (Bio 400)
451 – Ecology
453 L – (2) Ecology Lab***
456 – Seminar in Human Disease Genomics (Bio 400)
458 – Seminar in Animal Communication (Bio 400)

*The combinations of Bio 316/317 or Bio 463/464 alone cannot be used to fulfill the 6 credit lab requirement for the BS degree. Students may take these labs, but must complete one additional 2-4 credit lab course to satisfy the laboratory requirement.

** Because Bio 409 is a 1-credit lab experience, it cannot be used to satisfy the lab requirement for the BA degree in Biology.

***By petition to the Biology Department, this course can count as one of the two labs needed for the laboratory requirement for the BS degree.

Additional courses that may fulfill one of the above distribution areas by petition

The following courses have variable content and/or may have different focus depending on the instructor. Students intending to use one of these courses to fulfill the Distribution Requirement for Upper Division Biology Courses should inquire in the Biology Department Office as to how a given course could count before taking the course and petitioning.

Bio 490 – Independent Study

Bio 460 – Independent Research

Upper Division Biology Courses – Laboratory Requirement for the B.S. degree –

Note – Beginning in 2012, to earn the BS students have a 6-credit upper division lab credit requirement. Students matriculating in 2010 and 2011 will also be permitted to satisfy their degree requirements with 6 rather than 7 lab credits. A simple petition form for this request will be available in the Biology Office. Please be aware of the restrictions on use of specific course combinations (Bio 316, 317 and 463, 464) to satisfy the laboratory requirement as outlined below.

a) Choose **two** of the following:

- BIO 316 (Anatomy and Physiology I)*
- BIO 317 (Anatomy and Physiology II)*
- BIO 400 (Ecosystem Ecology Lab)
- BIO 400 (Global Change Ecology Lab)
- BIO 405 (Introduction to Field Biology)
- BIO 417 (Animal Behavior and Evolution Lab)
- BIO 422 (Bioinformatics for the Life Sciences)
- BIO 425 (Cell and Developmental Biology Lab)
- BIO 435 (Genetics Lab)
- BIO 453 (Ecology Lab)
- BIO 460 (Research in Biology - 4 credits maximum allowable)
- BIO 463 (Molecular Biotechnology)*
- BIO 464 (Applied Biotechnology)*
- BIO 465 (Molecular Biology Lab)
- BIO 472 (Advanced Light Microscopy)
- BIO 475 (Biochemistry Lab)
- CIE 471 (Environmental Chemistry and Analysis)
- CHE 477 (Preparation and Analysis of Proteins and Nucleic Acids)
- BTC 401 (Molecular Biology Techniques at SUNY-CESF)

*The combinations of Bio 316/317 or Bio 463/464 alone cannot be used to fulfill the 6 credit lab requirement for the BS degree. Students may take these labs, but must complete one additional 2-4 credit lab course to satisfy the laboratory requirement.

** Because Bio 409 is a 1-credit lab experience, it cannot be used to satisfy the lab requirement for the BA degree in Biology.

b) Other lab courses available

This can include another laboratory course listed under a), or an upper division biology course with a lab component, such as BIO 409 (Microbiology), BIO 460 (Research in Biology) for at least one credit, a 300 level or higher ESF course with a lab (by petition), or, by petition, an appropriate upper division laboratory course from a discipline related to biology (excluding CHE 326, Organic Chem. II laboratory).

Elective courses:

Credit limits for certain courses:

In any combination of Bio 360 (Biology Laboratory Assistant), BIO 419 (Thesis Seminar), BIO 460 (Research in Biology), BIO 470 or 490 (Independent Study), and BIO 495 or 499 (Biology Thesis), a maximum of four credit hours can be applied toward the BS degree credit hour requirement for any purpose.

a) Communication Skills Course Requirement

These courses are to develop skills in both oral and written communication. The requirement can be completed with any one of the following:

BIO 400 Biomimicry	BIO 405 (Introduction to Field Biology)
BIO 400 Comparing Sperm and Pollen Evolution	BIO 417 (Animal Behavior and Evolution Lab)
BIO 400 Ecosystem Ecology Laboratory	BIO 419 (Thesis Seminar) plus Bio 495 or 499
BIO 400 Experimental Designs&Interpretations	BIO 421 (Capstone Seminar in Biotechnology)
BIO 499 Food for Thought (Brain Bioenergetics)	BIO 425 (Cell and Developmental Bio Lab)
BIO 400 Global Change Biology	BIO 428 (Capstone Seminar in Env. Sciences)
BIO 400 <u>Isotopic Approaches in Global Change Eco</u>	BIO 432 (Global Change Ecology Laboratory)
BIO 400 Neurochemistry of Memory	BIO 437 Seminar in Develop. Neuro. (Bio 400)
BIO 400 Neurodegenerative Diseases	BIO 439 Seminar in Ecosystem Ecology (Bio 400)
BIO 400 Rhythms of the Brain	BIO 441 Seminar in Infectious Diseases (Bio 300)
BIO 400 Seminar in Disturbance Ecology	BIO 442 Seminar in Model Organism Genetics (Bio 400)
BIO 400 <u>Seminar in Molecular Ecology</u>	BIO 443 Seminar in Epigenetics (Bio 400)
BIO 400 <u>Seminar in Ecosystem Science</u>	BIO 444 Seminar in Neurotoxicology (Bio 400)
BIO 400 <u>Sem: Epigenetics of Human Health & Disease</u>	BIO 450 Seminar in Evolutionary Genetics (Bio 400)
BIO 400 <u>Seminar in Cell Bio & the Cytoskeleton</u>	BIO 453 (Ecology Lab)
BIO 400 Sexual Selection	BIO 456 Seminar in Human Disease Genomics (Bio 400)
BIO 400 Sexual Selection and Mating Strategies	BIO 458 Seminar in Animal Communication (Bio 400)
BIO 400 Species Interactions and Biodiversity	BIO 463 (Molecular Biotechnology)
BIO 400 Topics in Evolution and Ecology	BIO 464 (Applied Biotechnology)
	BIO 465 (Molecular Biology Lab)
	BIO 472 (Advanced Light Microscopy)

b) Other elective courses:

These can include any 300 level or higher Biology Department courses except courses designated not for majors. Elective courses should be taken to complete the required 22 credits of upper division courses beyond the Core courses.

Petition for elective credits outside Biology:

By approval through a petition to the Biology Department, a maximum of six credits of 300 to 600 level courses related to Biology from other departments (for example, Bioengineering, Chemistry, Earth Science, Physics, Psychology, Math, ESF) may be included as part of the elective requirement. CHE 325/326 (Organic Chem. II) may not be used for this purpose. Petitions can be obtained from the Undergraduate Secretary, room 114 LSC.

Total Minimum Biology hours required:

38

Biology – B.A. - Degree Requirements (43 to 45 total credit hours)

Students with 8 credits of Advanced Placement may omit the Introductory Biology courses.

Introductory Biology:

Required hours

BIO 121/123/124 (General Biology I & II)	8
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Core Courses in Biology*:

BIO 326 (Cell Biology)	(Fall)	3
BIO 327 (Genetics)	(Spring)	3
BIO 345 (Ecology and Evolution)	(Fall)	3
BIO 305 (Integrative Biology Laboratory)	(Spring)	3

(12 hrs total for Core)

*note that as of 2012, students must achieve a C+ or better in at least two core courses prior to being allowed to declare the Biology major

Upper Division Courses in Biology (12 credit hours total)

Credit limits for certain courses:

In any combination of Bio 360 (Biology Laboratory Assistant), BIO 419 (Thesis Seminar), BIO 460 (Research in Biology), BIO 470 or 490 (Independent Study), and BIO 495 or 499 (Biology Thesis), a maximum of four credit hours can be applied toward the BA degree credit hour requirement for any purpose.

1) Laboratory course:

a) Choose **one** of the following:

- BIO 316 (Anatomy and Physiology I)
- BIO 317 (Anatomy and Physiology II)
- BIO 400 (Ecosystem Ecology Lab)
- BIO 405 (Introduction to Field Biology)
- BIO 417 (Animal Behavior and Evolution Lab)
- BIO 422 (Bioinformatics for the Life Sciences)
- BIO 425 (Cell and Developmental Biology Lab)
- BIO 432 (Global Change Ecology Lab)
- BIO 435 (Genetics Lab)
- BIO 453 (Ecology Lab)
- BIO 460 (Research in Biology - 3 credits)
- BIO 463 (Molecular Biotechnology)
- BIO 464 (Applied Biotechnology)
- BIO 465 (Molecular Biology Lab)
- BIO 472 (Advanced Light Microscopy)
- BIO 475 (Biochemistry Lab)
- CIE 471 (Environmental Chemistry and Analysis)
- CHE 477 (Proteins and Nucleic Acids Lab)
- BTC 401 (Molecular Biology Techniques at SUNY-CESF)

2) Elective courses:

These can include any 300 level or higher Biology Department courses except courses designated not for majors. Elective courses should be taken to complete the required 12 credits of upper-division courses beyond the four Core courses.

Petition for elective credits outside Biology:

By approval through a petition to the Biology Department, a maximum of six credits of 300 to 600 level courses related to Biology from other departments (for example, Bioengineering, Chemistry, Physics, Psychology, Math, ESF) may be included as part of the elective requirement. CHE 325/326 (Organic Chemistry II) may not be used for this purpose. Petitions can be obtained from the Undergraduate Secretary, room 114 LSC.

Total Biology hours required:	32
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Non-departmental BA Degree Requirements

CHE 106/107 (General Chemistry I with lab)

4

CHE 116/117 (General Chemistry II with lab)

4

And select **one** of the following:

CHE 275/276 (Organic Chemistry I with lab), or

5

Either MAT 285 (Calculus I) or MAT 295*

3-4

Total non-biology hours required: 11-13

* Either MAT sequence satisfies the quantitative skills requirement in the liberal arts core.

Total hours required:	43 - 45
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Biochemistry- B.S. – Degree Requirements

Core Courses (48-60 credits)

- ☐ BIO 121: General Biology or Advanced Placement Biology Credit
- ☐ BIO 305: Integrative Biology Lab
- ☐ CHE 106/107 or 109/129: General Chemistry I/Lab
- ☐ CHE 116/117 or 119/139: General Chemistry II/Lab
- ☐ CHE 275/276: Organic Chemistry I/Lab
- ☐ CHE 325/326: Organic Chemistry II/Lab
- ☐ MAT 285 or 295: Calculus I
- ☐ MAT 286 or 296: Calculus II
- ☐ PHY 211/221: General Physics I/Lab
- ☐ PHY 212/222: General Physics II/Lab
- ☐ BIO 326: Genetics
- ☐ BIO 327: Cell Biology
- ☐ CHE 474: Structural and Physical Biochemistry
- ☐ BIO 475 or CHE/BCM 477: Biochemistry Lab or Preparation and Analysis of Proteins and Nucleic Acids Lab

- ☐ BCM 475: Biochemistry I
- ☐ BCM 476: Biochemistry II

Elective Courses (At least 12 credits, including at least one instructional lab indicated with an asterisk)

- ☐ CHE 335: Chemical and Biochemical Analysis Lab*
- ☐ CHE 346: Physical Chemistry I
- ☐ CHE 356: Physical Chemistry II
- ☐ BIO 409: Microbiology*
- ☐ CHE 412: Metals in Medicine
- ☐ BIO 422: Bioinformatics for Life Sciences w/Lab*
- ☐ BIO 425: Cell and Development Biology Lab*
- ☐ CHE 427: Organic Chemistry of Biological Molecules
- ☐ BCM 430: Journal Club in Molecular Pharmacology and Structural Biology
- ☐ BIO 447: Immunobiology
- ☐ BCM 460: Research in Biochemistry
- ☐ BIO 462: Molecular Genetics
- ☐ BIO 463: Molecular Biotechnology Lab*
- ☐ BIO 464: Applied Biotechnology Lab*
- ☐ BIO 465: Molecular Biology Lab*
- ☐ BCM 484: Biomolecular Modeling w/Lab*
- ☐ BIO 501: Biology of Cancer
- ☐ BIO 503: Developmental Biology
- ☐ CHE 546: Molecular Spectroscopy and Structure
- ☐ CHE 575: Organic Spectroscopy

If both BIO 475 and CHE/BCM 477 are taken, one may count toward the 12-credit elective requirement, thereby also meeting the instructional lab requirement.

BCM 460 counts once (up to 3 credits) towards elective requirement, but does not count as an instructional lab course.

RECOMMENDED ELECTIVES

Preparation for Graduate School in a Dept. of Biology, Biochemistry, or Molecular Biology

BIO 409: Microbiology
CHE 412: Metals in Medicine
CHE 427: Organic Chemistry of Biological Molecules
BCM 430: Journal Club in Molecular Pharmacology and Structural Biology
BIO 447: Basic Immunology
BCM 460: Research in Biochemistry
BIO 462: Molecular Genetics
BIO 463: Molecular Biotechnology Lab
BIO 464: Applied Biotechnology Lab
BIO 465: Molecular Biology Lab
BCM 484: Biomolecular Modeling w/Lab
BIO 501: Biology of Cancer
BIO 503: Developmental Biology

Preparation for Graduate School in a Dept. of Chemistry

CHE 335: Chemical and Biochemical Analysis Lab
CHE 346: Physical Chemistry I
CHE 356: Physical Chemistry II
CHE 412: Metals in Medicine
CHE 427: Organic Chemistry of Biological Molecules
BCM 430: Journal Club in Molecular Pharmacology and Structural Biology
BCM 460: Research in Biochemistry
BIO 465: Molecular Biology Lab
BCM 484: Biomolecular Modeling w/Lab
CHE 546: Molecular Spectroscopy and Structure
CHE 575: Organic Spectroscopy

Preparation for Health Professions (M.D., D.D.S., D.V.M.)

BIO 409: Microbiology
CHE 412: Metals in Medicine
BIO 447: Immunobiology
BCM 460: Research in Biochemistry
BIO 462: Molecular Genetics
BIO 465: Molecular Biology Lab
BIO 501: Biology of Cancer
BIO 503: Developmental Biology

Preparation for Technical Careers in Pharmaceutical or Biotechnical Industry

CHE 335: Chemical and Biochemical Analysis Lab
CHE 412: Metals in Medicine
BIO 409: Microbiology
CHE 427: Organic Chemistry of Biological Molecules
BCM 430: Journal Club in Molecular Pharmacology and Structural Biology
BIO 447: Basic Immunology
BCM 460: Research in Biochemistry
BIO 462: Molecular Genetics
BIO 463: Molecular Biotechnology Lab
BIO 464: Applied Biotechnology Lab
BIO 465: Molecular Biology Lab
BCM 484: Biomolecular Modeling w/Lab
BIO 501: Biology of Cancer
BIO 503: Developmental Biology
CHE 575: Organic Spectroscopy

BIOTECHNOLOGY - B.S. Degree Requirements – Total Credits (57-66)

INTRODUCTORY BIOLOGY (4 credits)

- BIO 121 (*Students with AP credits of Biology with laboratory may omit introductory courses*)

CORE COURSES (9 credits)

- BIO 326, BIO 327 and BIO 305 (3 credits each)

*note that as of 2012, students must achieve a C+ or better in at least two core courses prior to being allowed to declare the Biotechnology major

UPPER DIVISION REQUIREMENTS (Total 29 credits)

1. Biotechnology courses (8 credits)

- BIO 463: Molecular Biotechnology (4 credits; 3 credits count towards lab)
- BIO 464: Applied Biotechnology (4 credits; 3 credits count towards lab)

2. Bioengineering/Biomaterial Sciences (3 credits)

- BEN 468 (Biomaterial and Medical Devices; 3 credits)

3. Public Policy/Management (6 credits)

- EEE 370 (Introduction to Entrepreneurship and Emerging Enterprises; 3 credits)
- ECO 301 (Intermediate microeconomics; 3 credits)

4. Elective courses (6 credits)

Choose two of the following courses – additional Biology courses may be appropriate – consult Biotechnology Program Directors for information on petitioning such courses:

- ACC 201 (Introduction to Accounting; 3 credits)
- BEN 541 (Principles of Tissue Engineering; 3 credits)
- BIO 345 (Ecology & Evolution; 3 credits)
- BIO 316 (Anatomy and Physiology I)
- BIO 317 (Anatomy and Physiology II)
- BIO 355 (General Physiology; 3 credits)
- BIO 400 (Neurochemistry and Memory; 3 credits)
- BIO 400 (Neurodegenerative Diseases; 3 credits)
- BIO 409 (General Microbiology; 4 credits)
- BIO 422 (Bioinformatics for Life Scientists; 3 credits)
- BIO 425 (Cell and Developmental Biology Lab; 3 credits)
- BIO 435 (Genetics Lab; 3 credits)
- BIO 437 (Seminar in Developmental Neuroscience; 3 credits)
- BIO 443 (Seminar in Epigenetics; 3 credits)
- BIO 447 (Basic Immunology; 3 credits)

- BIO 448 (Evolutionary Medicine; 3 credits)
- BIO 450 (Seminar in Evolutionary Genetics; 3 credits)
- BIO 456 (Seminar in Human Disease Genomics; 3 credits)
- BIO 462 (Molecular Genetics; 3 credits)
- BIO 465 (Molecular Biology Lab; 3 credits)
- BIO 475 (Biochemistry Lab; 3 credits)
- BIO 501 (Biology of Cancer; 3 credits)
- BIO 503 (Developmental Biology; 3 credits)
- BIO 565 (Cellular Physiology; 3 credits)
- BCM 475 (General Biochemistry I; 3 credits)
- BCM 476 (General Biochemistry II; 3 credits)
- BCM 484 (Biomolecular Modeling; 3 credits)
- BTC 401 (Molecular Biology Techniques; 3 credits)
- BPE 420 (Bioseparations Engineering; 3 credits)
- BPE 421 Bioprocess Kinetics and Systems Engineering; 3 credits)
- BPE 440 Bioprocess Kinetics and Systems Engineering Laboratory; 3 credits)
- BPE 481 Bioprocess Engineering Design; 3 credits)
- CHE 412 (Metals in Medicine; 3 credits)
- CHE 477 (Proteins & Nucleic Acids Lab; 3 credits)
- CIE 472 (Applied Environmental Microbiology; 3 credits)
- GEO 400 (Food: A Critical Geography; 3 credits)
- LPP 255 (Introduction to the Legal System; 3 credits)
- MAR 301 (Principles of Marketing for Non-Management Students; 3 credits)
- PAF 410 (Practicum in Public Policy; 3 credits)
- PAF 451 (Environmental Policy; 3 credits)
- PHI 393 (Contemporary Ethics; 3 credits)
- PSC 318 (Technology, Politics, and Environment; 3 credits)
- PAF 315 (Methods of Public Policy Analysis and Presentation; 3 credits)
- SHR 355 (Strategic Human Resource Management; 3 credits)
- In addition, other courses related to biotechnology from other departments (for example, Chemistry, Bioengineering, Physics, Psychology, Biomaterial Institute, Maxwell School, Law School, Whitman School, ESF and Upstate Medical University) can be used as elective courses by petitioning to the Biology Department.

5. SENIOR CAPSTONE SEMINAR COURSE (BIO 421; 3 credits)

6. INTERNSHIP/Independent Research (BIO 461/BIO 460; 0-4 credits)

This requirement can be fulfilled by a) completing an approved internship at a biotech-related company during spring and/or fall semester of junior or senior year or b) by completing an approved independent research in any of the biotech-related topics, including biology, chemistry, engineering, public policy, law or management. For example, if a student chooses to do independent research in biology, s/he can register for 3 credits of BIO 460 each semester. In addition, an approved internship at a biotech-related company over the summer after the junior year can be petitioned to fulfill this requirement.

Biotechnology Degree Requirements (continued) –

7. MATH AND CHEMISTRY REQUIREMENTS (19-21 credits)

- Chem 106/107: General Chemistry I (4 credit hours)
Chem 116/117: General Chemistry II (4 credit hours)
Chem 275/276: Organic Chemistry I (5 credit hours)
AND either
- Math 285/286: Calculus I and II* (6 credit hours total)
OR
- Math 295/296: Calculus I and II* (8 credit hours total)
OR
- Math 285 or 295: Calculus I and a 300 level Statistics Course* (6-7 credit hours total)

BS Degree Requirements- Biology with Focus on Environmental Sciences (62 to 66 credit hours)

Students with 6 credits of Advanced Placement may omit the Bio 121 General Biology course.

Introductory Biology Core:

Required hours

BIO 121 General Biology		4
BIO 345 Ecology and Evolution	(Fall)	3
BIO 305 Integrative Biology Laboratory	(Spring)	3

Introductory Earth Science Core:

select 2 of the following:

6-7 credits

EAR 101 Dynamic Earth		4
EAR 102 History of Earth and Life		3
EAR 106 Environmental Geology		3
EAR 111 Climate Change-Past and Present		3
EAR 117 Oceanography		3
EAR 203 Earth System Science		4

Additional Requirements in Cognate Sciences and Math (17 to 19 credit hours)

Either MAT 285/286 or MAT 295/296	6 or 8
Or MAT 285 or 295, plus Statistics	6 or 7
And	
2 semesters General Chemistry with laboratories	8
1 semester Organic Chemistry lecture (CHE 275)	3

Upper Division Requirements:

Select 24 credit hours from the following. At least 15 hours must be in Biology courses. One course must be a laboratory. (Appropriate substitutions may be made by petition to the Environmental Science Advisor, Dr. Doug Frank.)

Upper Division Laboratory:

choose one of the following:

3-4 credits

BIO 400 Global Change Ecology Laboratory	3
BIO 405 Introduction to Field Biology	4
BIO 417 Animal Behavior/Evolution Laboratory	3
BIO 432 Environmental Microbiology Laboratory	3
CIE 471 Environmental Chemistry and Analysis	3

Others by petition

Environmental Science Focus Requirements (continued) -

Upper Division Electives

in combination with lab
must total to 24 credits

BIO 400 Sexual Selection	3
BIO 400 Genome Evolution	3
BIO 405 Introduction to Field Biology	4
BIO 409 Microbiology	4
BIO 415 Conservation Biology	3
BIO 417 Animal Behavior/Evolution Laboratory	3
BIO 439 Ecosystem Ecology	3
BIO 450 Seminar in Evolutionary Genetics	3
BIO 451 Ecology	3
BIO 453 Ecology laboratory	3
BIO 458 Seminar in Animal Communication	3
CIE 471 Environmental Chemistry and Analysis	3
CIE 472 Applied Environmental Microbiology	3
CIE 554 Principles of Environmental Toxicology	3
CIE 555 Hazardous Waste Management	3
CIE 561 Air Resources I	3
EAR 314 Mineralogy	4
EAR 317 Sedimentary Processes and Systems	3
EAR 325 Introduction to Paleobiology	3
EAR 333 Structural Geology	4
EAR 345 Global Change: The Geologic Record	3
EAR 402 Introduction to Geophysical Methods	3
GEO 305 Population Change	3
GEO 314 Hazardous Geographic Environments	3
GEO 215 Global Environmental Change	3
GEO 316 River Environments	3
GEO 317 Geography of Mountain Environments	3
GEO 318 Tropical Environments	3
GEO 319 Cold Environments	3
GEO 322/LAS 329 Globalization and Environ. in Latin America	3
GEO 326 The Geography of Climate and Weather	3
GEO 353 Geographies of Environmental Justice	3
GEO 354/HST 384 American Environ. History and Geography	3
GEO 356 Environmental Ideas and Policy	3
GEO 383/683 Geographic Information Systems	4
GEO 386 Quantitative Geographical Analysis	3
GEO 555 Biogeography	3

Required Senior Capstone Course

BIO/EAR 428 (Capstone Environmental Seminar)	3
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Environmental Science Focus Requirements (continued) -

Additional Available Courses

Several courses in the College of Environmental Science and Forestry also will be available for students in this program, such as:

EFB 415 (Ecological Biogeochemistry)	3
EFB 505 (Microbial Ecology)	3
EFB 524 (Limnology)	3
EFB 525 (Limnology Laboratory)	1
FCH 515 (Methods of Environmental Chemical Analysis)	3
FEG 352 (Introduction to Remote Sensing)	3

Minor in Biology Requirements (20 credit hours)

Students with 8 credits of Advanced Placement may omit the Introductory Biology courses.*

Introductory Biology:

Required hours

BIO 121/123/124 (General Biology I & II)	8
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Select one to four of the following:

BIO 326 (Genetics) (Spring)	3
BIO 327 (Cell Biology) (Fall)	3
BIO 345 (Ecology and Evolution) (Fall)	3
BIO 305 (Integrative Biology Laboratory) (Spring)	3
BIO 355 (General Physiology)	3

3 – 12

Other possible courses

These can include any other 300 to 600 level Biology Department courses except those designated not for majors. However, many of these courses have prerequisites of BIO 326, BIO 327, or BIO 345, so those of the above courses you take will influence others you should select as electives. BIO 460 (Research in Biology) may be used for a maximum of two credit hours toward a Minor in Biology.

By approval through petition to the Biology Department, a maximum of six credits of 300 to 600 level courses related to Biology from other departments (for example, Bioengineering, Chemistry, Physics, Psychology, Math, ESF) may be included as part of the elective requirement. CHE 325/326 (Organic Chemistry II) may not be used for this purpose. Petitions can be obtained from the Undergraduate Secretary, room 114 LSC.

Total Biology hours required:	20
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***Note:** Students with 6 AP credits for Introductory Biology courses must take a minimum of 15 credits of graded courses for the Minor (a total of 21 credits).

Revised 8/22/17