

REQUIREMENTS FOR MAJORS

3/2 ENGINEERING

BIOLOGY

BIOCHEMISTRY

BIOPHYSICS

CHEMISTRY

ENVIRONMENTAL ANALYSIS

ENVIRONMENT, ECONOMICS, AND POLITICS

MOLECULAR BIOLOGY

NEUROSCIENCE

ORGANISMAL BIOLOGY

PHYSICS

SCIENCE MANAGEMENT

**KECK SCIENCE DEPARTMENT
SCRIPPS COLLEGE**

2020-2021

Scripps College

Keck Science Department

3/2 ENGINEERING

A five- year program, offered in conjunction with other institutions, allows students to receive both a Bachelor of Arts Degree in 3/2 Engineering from Scripps and a Bachelor of Science Degree in Engineering from the second institution. The first three years of study are undertaken on the Scripps campus. After this, students enroll in the engineering programs at other institutions. Upon completion of the two-year engineering program, graduates simultaneously receive an engineering degree from the second institution and a Bachelor of Arts degree from Scripps. Although formal programs exist with Harvey Mudd College, and Columbia University, students can transfer to other engineering programs. It is essential for students to plan courses carefully and early in the program. Details of specific course requirements, recommendations, and general program expectations may be obtained from Professor S. Gould, the Program Director, at sgould@kecksci.claremont.edu.

AFTER GRADUATION

Most graduates go directly into industry, where they are welcomed. The 3/2 Engineering graduate has a combination of technical skill, and breadth of understanding that constitutes the essentials of sound decision making. She can deal with engineering problems and understand at the same time the realities of the market place.

MAJOR REQUIREMENTS:

Mathematics 30, 31, 32, and Differential Equations (SC Math 102, CMC Math 111, HMC Math 82, or PO Math 102).

Chemistry 14L.

Physics 33L, 34L, and 35.

Two advanced physics courses (normally 101, 106L or 107).

Course in computing (CMC CSCI 51, HMC CS5, or Physics 108).

Chemical engineers should take Organic Chemistry 116L-117L or Physical Chemistry 121-122.

Biomedical engineers should take Biology 43L.

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BIOLOGY MAJOR

Career opportunities for those who major in biology are numerous. Besides being one of the traditional preparatory fields for those pursuing careers as health care professionals, Biology is an excellent choice of major for those interested in secondary education, ecology, or the burgeoning genetic engineering industry. And, of course, the areas of academic and industrial research are open to those who pursue a Ph.D. in the discipline.

These course requirements should be considered a minimum program in biology. Students wishing to continue their education in biology-related graduate or professional school programs will need to supplement this basic curriculum with additional course work in the natural sciences. **Suggested programs are available, and Keck Science faculty should be consulted for advice at the earliest possible opportunity.**

Required Courses:

1. Biology Foundation courses:

- Introductory Biology: BIOL043L KS and BIOL044L KS; or BIOL040L KS and BIOL044L KS; or BIOL042L KS and BIOL044L KS;
- Introductory Chemistry: CHEM014L KS and CHEM015L KS; or CHEM040L KS and CHEM015L KS; or CHEM014L KS and CHEM042L KS; or CHEM029L KS
- Calculus I: MATH030 or equivalent

2. Three STEM Breadth courses selected from the list below. Breadth courses may not be double-counted as Foundation or Elective courses. Courses should be selected in consultation with a Keck Science advisor. Note that some courses in this list may be required pre-requisites for some upper division biology courses.

- Up to two courses in Organic Chemistry (CHEM 116L, CHEM 117L KS)
- Up to two courses in General Physics (PHYS 30L KS, PHYS 31L KS, or PHYS 33L KS, PHYS 34L KS)
- One introductory course in computer programming (CS00, MATH 042 SC, CS 005G HM, or equivalent).
- One math course for which MATH 030 or higher is listed as a prerequisite
- One upper division Environmental Science course taught by the Keck Science Dept. (e.g., EA100KS, EA103KS, EA104KS)
- One course in the history, philosophy, or ethics of science (e.g. HIST 082 HM, PHIL 103 PZ, PHIL 038 P0)

3. Six^{††} Biology Elective courses, numbered 100 or higher, including at least three laboratory courses (indicated by the "L" subscript). Elective courses may not be double counted as foundation or breadth courses.

4. Senior Thesis in Biology, complete one of the following options. *Students must register their thesis plans with the Keck Science Department during the spring semester of their penultimate year.*

- BIOL 191 KS, one-semester thesis in biology
- BIOL 188L KS and BIOL 1190L KS, two-semester thesis in biology
- BIOL 189L KS and BIOL 190L KS, two-semester thesis in biology with a summer research component

‡Note: Dual majors (SC/CMC) in Biology need only 4 Biology Elective Courses (at least two with lab)

* Note: Students wishing to continue their education in biology-related graduate or professional school programs may need to supplement this basic curriculum with additional course work in science. Department faculty should be consulted for advice at the earliest possible opportunity.

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BIOCHEMISTRY MAJOR

This is a combined major at the interface of biology and chemistry that partially overlaps the requirements for those two individual majors. It is particularly appropriate for those going on to graduate work and also provides a strong background for those entering medical, dental, and veterinary school.

MAJOR REQUIREMENTS:

Biology 43L and either Biology 44L, or Biology 143, or Biology 40L and either Biology 44L, or Biology 143, or Biology 42L and Biology 44L, or Biology 143	Introductory Biology Genetics Introduction to Biological Chemistry
Biology 157L Biology 170L Biology 177	Integrated Biology and Chemistry Cell Biology Molecular Biology Biochemistry
Chemistry 14L, 15L, or Chemistry 29L, or Chemistry 40L and 15L, or Chemistry 42L	Basic Principles of Chemistry Accelerated General Chemistry Introduction to Biological Chemistry Integrated Biology and Chemistry
Chemistry 116L, 117L Chemistry 121,122	Organic Chemistry Principles of Physical Chemistry
Any two of the following three Advanced Lab courses: Chemistry 125L Chemistry 126L Chemistry 127L	Advanced Lab in Biochemistry Advanced Lab in Chemistry Advanced Lab in Chemistry
Physics 30L, 31L, or Physics 33L and 34L	General Physics for the Life Sciences Principles of Physics
Mathematics 30, 31	Calculus I, II
Bio/Phys/Chem 191 or 188L/190L or 189L/190L*	One or two-semester Thesis in Science

* Biochemistry majors are encouraged to do a two-semester thesis.

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BIOPHYSICS MAJOR

Biophysics

The Biophysics major integrates the physical principles that are part of the core material found in a traditional physics major with areas of interest in the life sciences. Offering many possible avenues via molecular/cellular, biomechanical, organismal and/or physiological sequences, the major is appropriate for students interested in attending graduate school in physics or biophysics and provides a solid background for students planning a career in the health fields.

Requirements for the Major in Biophysics

1. Foundation courses:

- a. Introductory Biology (two semesters: Biology 43L–44L, or Biology 40L, Introduction to Biological Chemistry and 44L, Biology 42L, Integrated Biology and Chemistry and Biology 44L, or equivalent);
- b. Basic Principles of Chemistry (two semesters: Chemistry 14L–15L, or Chemistry 40L, Introduction to Biological Chemistry and Chemistry 15L, or Chemistry 29L, Accelerated General Chemistry, or Chemistry 42L, Integrated Biology and Chemistry, or equivalent);
- c. General Physics for the Life Sciences (two semesters: Physics 30L–31L, or Principles of Physics, Physics 33L–34L, or equivalent);
- d. Modern Physics with Computational Applications (Physics 35);
- e. Biophysics (Physics 178 or equivalent);
- f. Calculus III (Mathematics 32); Differential Equations (Mathematics 111 or equivalent);
- g. One computer programming course (CS 5 HMC, CS 51 CMC or Physics 108 KS).

2. Five Additional Advanced Courses:

- a. Three (3) upper-division courses from Biology. Organic Chemistry (Chemistry 116L) may be substituted for one of the three upper-division Biology courses, but one of the remaining two upper-division Biology courses must still include a laboratory component.
- b. At least two (2) of the following four (4) courses: Physics 101, Physics 102, Physics 114, Physics 115.

3. Senior Thesis (one- or two-semester).

A study abroad experience is strongly encouraged but not required.

NOTE: For Biophysics majors, PHYS 30L–31L may substitute for PHYS 33L–34L as a prerequisite.

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CHEMISTRY MAJOR

The student of chemistry examines, describes, and explores the composition, structure, and properties of substances and the changes they undergo. This curriculum provides a firm foundation in the principles of chemistry as well as sufficient experience to prepare the student for basic research, secondary school teaching, the pursuit of a career in medicine, or graduate study in the field. The Keck Science chemistry major is accredited by the American Chemical Society (ACS).

Requirements for the Major in Chemistry

The major in chemistry requires a minimum of 13-15 courses:

1. Chemistry 14L-15L, Basic Principles of Chemistry, or Chemistry 29L, Accelerated General Chemistry, or Chemistry 40L-15L, Introduction to Biological Chemistry, or Chemistry 42L, Integrated Biology and Chemistry.
2. Chemistry 116L-117L, Organic Chemistry.
3. Chemistry 121-122, Principles of Physical Chemistry.
4. Physics 33L-34L, Principles of Physics, or Physics 30L-31L, General Physics for the Life Sciences, with permission of advisor.
5. Chemistry 126L-127L, Advanced Laboratory in Chemistry.
6. Chemistry 128, Inorganic Chemistry.
7. Chemistry 177, Biochemistry.
8. Electives: one advanced elective (or two half courses) in chemistry, molecular biology, or interdisciplinary electives involving chemical concepts or techniques, chosen in consultation with the chemistry faculty.
9. Senior Thesis in Chemistry: chemistry majors must complete one of the following: Chemistry 188L-190L, Chemistry 189L-190L, or Chemistry 191. For further information, see "Senior Thesis in Science".
Note: Students must do a two-semester research thesis (Chem 188L-Chem 190L or Chem 189L-Chem 190L) in order to complete the ACS accredited major in chemistry.

NOTES: Mathematics 31, Calculus II is co-required for Chemistry 121, Mathematics 32, Calculus III is co-required for Chemistry 122 and Biology 43L, Introductory Biology, or Biology 40L, Introduction to Biological Chemistry, or Chemistry 42L, Integrated Biology and Chemistry, is co-required for Chemistry 177. Additional electives in chemistry, mathematics, physics and computer science are strongly recommended for all chemistry majors.

Requirements for the Minor in Chemistry

A minor in chemistry consists of Introductory Chemistry 14L and 15L (or Chemistry 29L), or Chemistry 40L and 15L, or Chemistry 42L and four upper-division courses (Chemistry 116L or higher). The four courses should be chosen in consultation with a member of the chemistry faculty to provide a coherent overall program.

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Environmental Analysis Major Program

Scripps College participates with Claremont McKenna, Harvey Mudd, Pitzer, and Pomona Colleges in a 5-college collaboration that allows students to take advantage of a broad range of courses, facilities, and opportunities in the study of environmental issues.

The Environmental Analysis (EA) Program is designed to prepare students for careers in many environmental problem-solving fields, including law, policy, medicine, chemistry, conservation, global climate change, urban planning, and resource management. It also provides a solid background for careers in environmental education and community environmental action. The program regards Off-Campus Study as a vital, strongly encouraged, part of the major experience, enabling students to secure a deeper appreciation for the global dimensions of our environmental situation. Specially focused environmental Off-Campus Study semesters include programs in Australia, Costa Rica, Botswana, Ecuador, New Zealand, and South Africa.

Below are the requirements for the *EA: Environmental Science* track. Students interested in the *Environmental Policy or Environment: Society and the Environment* track should see the Scripps Catalog for the major requirements.

MAJOR REQUIREMENTS:

The major consists of three sets of requirements:

1) *Introductory Core*

2) *One Specialized Field* in which to develop a course plan:

- *Environmental Science*
- *Environmental Policy*
- *Society and the Environment*
- *Sustainability and the Built Environment*

3) *A senior thesis capstone of two courses for the Environmental Science Track*

Environmental Science Specialized Field:

A major in Environmental Analysis (Science track) requires a minimum of 14 courses and a senior thesis. Students interested in this major/track should discuss the eligibility of specific courses with their faculty advisor and with EA science faculty.

- *Introductory Core:* EA 010 PO, and either EA 020 PO or EA 086 PZ or POLI 136 PO and EA 030L KS
- *Introductory Biology:* BIOL 044L

- Introductory Chemistry: CHEM 014L or CHEM 040L or CHEM 029L or CHEM 042L
- One introductory Earth science course (e.g., EA 55L KS or PO GEOL 020, or approved alternate)
- Six upper-division EA-approved science courses (or comparable courses approved by Keck Science EA faculty): at least three of these courses must include a laboratory component.
- One statistics/quantitative course (can be double-counted)
- One course in economics, government, or environmental policy approved by an EA adviser
- Senior Capstone (two courses) to include ONE of the following TWO options:
A one-semester thesis in Environmental Analysis (EA 191 KS), or
A two-semester thesis in Environmental Analysis (EA 188L KS/ EA 190L KS, or EA 189L KS/ EA 190L KS)

Keck Science Common Learning Outcomes

Students completing a major in the Keck Science Department should demonstrate the ability to:

1. Use foundational principles to analyze problems in nature.
2. Develop hypotheses and test them using quantitative techniques.
3. Articulate applications of science in the modern world.
4. Effectively communicate scientific concepts both verbally and in writing.

Student Learning Outcomes

An Environmental Analysis Major should be able to:

- Understand and describe the complex social, scientific and humanistic aspects of environmental issues.
- Understand and apply both disciplinary and interdisciplinary analysis to environmental issues.
- Critically analyze, evaluate, and interpret scholarly arguments and popular discourse and be able to communicate this analysis to a variety of communities.
- Develop well-reasoned solutions to environmental predicaments, testing them against relevant criteria and standards.
- Be able to craft well-researched, informative and effective scholarly presentations.
- Contribute knowledge and action regarding environmental issues to the public through service learning, internships, community-based-research, and other activities.

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ENVIRONMENT, ECONOMICS, AND POLITICS

The Environment, Economics, and Politics (EEP) major emphasizes 21st-century problems and opportunities involving interrelated environmental, economic, and political issues. The EEP major provides students in economics and policy studies with a background in ecological analysis and environmental management. Students take basic courses in science, economics, politics, and mathematics, together with advanced courses in areas such as environmental law, environment and resource economics, politics and the environment, and natural resource management. Seniors participate in a clinic course directed toward a specific environmental project. In the clinic, small groups of students work together to complete field work, analyses, report preparation, and oral seminar presentations.

Requirements for the Major

1. Prerequisites (4 courses)

- a. Mathematics 30. Calculus I.
- b. Economics 51. Principles of Macroeconomics.
- c. Economics 52. Principles of Microeconomics.
- d. Politics 120. Introduction to American Politics.

2. Core Requirements (4 courses)

- a. Biology 43L-44L. Introductory Biology, or Biology 40L. Introduction to Biological Chemistry and 44L, or Biology 42L, Integrated Biology and Chemistry and 44L.
- b. Biology 137. EEP Clinic.
- c. Economics 172, Environmental Economics (PZ) (or Economics 118, Processes of Environmental Policymaking or Economics 142, Politics and Economics of Natural Resource Policy in Developing Countries, both CMC).

3. Electives (7 courses chosen in consultation with major adviser)

- a. Politics 103. Natural Resources in World Politics.
- b. Politics 113. Social Change in Third World Societies (or Economics 144, Economic Development, CMC).
- c. Chemistry 14L. Basic Principles of Chemistry, or Chemistry 40L. Introduction to Biological Chemistry (or one course from the list of biology or policy courses).
- d. Chemistry 15L. Basic Principles of Chemistry, or Chemistry 42L, Integrated Biology and Chemistry (or one course from the list of biology or policy courses).
- e. Economics 86. Introductory Accounting (or one course from the list of biology courses).
- f. One course from the list of biology courses.
- g. One course from the list of economics courses.
- h. One course from the list of mathematics/statistics courses.

4. Senior Thesis

EEP 191. Senior Thesis.

Honors Program in Environment, Economics and Politics

A student who is majoring in Environment, Economics and Politics may apply for honors if they have a minimum grade point average in the major of 11.0. This includes all the courses counted toward the major. She must also earn an A or A- on the Senior Thesis. She should inform their Scripps EEP advisor or Professor Branwen Williams in Keck Science of their intention, preferably by the latter part of their junior year.

The honors candidate who fulfills these criteria is required further to defend the senior thesis before their thesis readers, plus two additional faculty representatives – one from the Keck Science department, and another from either the Politics or Economics department at Scripps. It will be the responsibility of the student, once they have been accepted for honors candidacy, to make all arrangements for the defense.

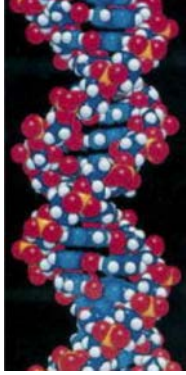
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MOLECULAR BIOLOGY

Molecular Biology: This interdisciplinary major is focused on biology and the physical sciences, and incorporates a significant amount of mathematics. The major is research oriented and is designed to prepare students for graduate studies or medical school, as well as careers in biotechnology and the pharmaceutical industry. For further information, consult with the molecular biology faculty, Professors Armstrong, Edwalds-Gilbert, Tang, or Wiley.

MAJOR REQUIREMENTS:

Biology 43L, or Biology 40L, or Biology 42L	Introductory Biology or Introduction to Biological Chemistry	
Chemistry 14L, 15L, or Chemistry 29L, or Chemistry 40L and 15L, or Chemistry 42L	Integrated Biology and Chemistry Introductory Chemistry Accelerated General Chemistry Introduction to Biological Chem Integrated Biology and Chemistry	
Mathematics 30, 31	Calculus I, II	
Biology 143	Genetics	
Chemistry 116L, 117L	Organic Chemistry	
Biology 173L	Mol. Biol. Seminar/Lab	
Physics 33L, 34L	Principles of Physics	
Biology 157L	Cell Biology	
Biology 170L	Molecular Biology	
Biology 177	Biochemistry	
Chemistry 121	Physical Chemistry I	
Biology 188L, 190L, or Biology 189L, 190L; or Biology 191	Two-semester thesis (preferred); One-semester thesis	

One additional Biology course with lab to be selected in consultation with the faculty advisor.

NOTES:

Biology 173L is a ½ credit sophomore level course, but juniors may take the course.

It is recommended that students take Genetics before Cell Biology and Molecular Biology.

Physics 33L, 34L are recommended, but Physics 30L, 31L may substitute.

For dual majors in Molecular Biology, students can only drop one upper-division elective.

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NEUROSCIENCE MAJOR

The major in Neuroscience is an interdisciplinary program of 16 courses (maximum) designed to provide students with an appreciation of diverse approaches to understanding the function of nervous systems, as well as the ability to conduct investigations within a particular subfield of interest. Students majoring in Neuroscience complete:

1. A common core program,
2. A sequence of four electives determined in consultation with an adviser in Neuroscience, and
3. A one- or two-semester thesis on a topic related to the four-course sequence.

The major provides good preparation for graduate work in biology, neuroscience, and a variety of other programs including medical school or other graduate health professions programs. Admission to particular advanced degree programs may require additional course work.

1. Common Core (5 courses)

- Introductory Biology (two semesters: Biology 43L-44L KS, or Biology 40L-44L KS, or Biology 42L-44L, or equivalent.
- Basic Principles of Chemistry (two semesters: Chemistry 14L-15L KS, or Chemistry 40L-15L KS, or CHEM 42L, or equivalent.
- Foundations of Neuroscience (Neuro 95 JT or an approved substitute).
- Neuroscience 1: Cell, Molecular: Biology/Neuroscience 148L KS.
- Neuroscience 2: Systems: Biology/Neuroscience 149 KS.

2. Common Core Electives (3 courses): Choose any 3 courses from the following:

- General Physics for the Life Sciences: Physics 30L-31L KS, or Principles of Physics, Physics 33L-34L KS. (Only one semester of physics may count.)
- Mathematics: Math 31 SC (Calculus II or calculus IIS PO), statistics (Biology 175 KS or Psychology 91 PZ, or PSYC 103 SC or PSYC 109 CM), or an approved equivalent course.
- Computer science: Biology 133L KS, Physics 100 KS, NEUR 182 SC, NEUR 123 SC/NEUR 123L SC, CS 005, MATH 42 SC, or an approved equivalent course.
- Research Methods: Psychology 104 SC/PSYC 104L SC, or PSYC 092 PZ or PSYC 110 CM/PSYC 111L CM, or an approved equivalent course.

3. Course elective specializations:

A coherent grouping of four elective courses to be determined in consultation with an adviser in Neuroscience and approved by the Coordinator of the Intercollegiate Neuroscience Program. Areas in which a student may elect to specialize include, but are not limited to,

- Behavioral Neuroscience,
- Cellular and Molecular Neuroscience,
- Clinical Neuroscience,
- Cognitive Neuroscience,

- Computational Neuroscience,
- Motor Control, or
- Neuropharmacology
- Philosophy of Neuroscience,
- Developmental Neuroscience

4. Senior Thesis (one or two courses)

A one- or two-semester Senior Thesis on a topic related to the student's selected Neuroscience Sequence. Students who choose the one-semester thesis option are required to take an additional course towards their neuroscience sequence.

- Neuroscience (NEUR) 188L and 190L, or 189L and 190L, two-semester thesis; or
- Neuroscience (NEUR) 191, one-semester thesis or equivalent for dual majors.

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ORGANISMAL BIOLOGY

This major provides a research-and-field-oriented background for students interested in research careers in either physiology or ecology/evolution and their allied fields. For further information, consult with the organismal biology/ecology faculty, Professors McFarlane, Preest, or Thomson.

MAJOR REQUIREMENTS

Biology 43L, 44L, or

 Biology 40L and 44L, or

 Biology 42L, 44L

Chemistry 14L, 15L, or

 Chemistry 29L, or

 Chemistry 40L and 15L, or

 Chemistry 42L

Mathematics 30

Biology 175

Physics 30L, 31L

Biology 120

Introductory Biology

Introduction to Biological Chemistry

Integrated Biology and Chemistry

Basic Principles of Chemistry

Accelerated General Chemistry

Introduction to Biological Chemistry

Integrated Biology and Chemistry

Calculus I

Biostatistics, or equivalent

General Physics for the Life Sciences

Research Tools for Organismal Bio

Seven upper division biology courses, including 3 with lab. At least six courses must be taken from the 4 groups listed below, with at least one course from each group AND at least 3 from Group 1 or Group 3. No more than one course from Group 4 may be counted. Other biology courses may also be appropriate to fulfill the group requirements, if approved in advance by the biology faculty. One upper-division Environmental Analysis course offered by Keck Science may count as a non-lab elective but will not count towards any of the Group requirements.

Group 1:

- Biology 129. Neuromuscular Physiology in Health and Disease
- Biology 131L. Vertebrate Physiology
- Biology 132L. Comparative Physiology
- Biology 133L. Mathematical Physiology
- Biology 140. Selected Topics in Neuroscience
- Biology 141L. Vertebrate Anatomy
- Biology 149. Neuroscience II: Systems
- Biology 150La. Human Anatomy: Limbs and Movement
- Biology 150Lb. Human Anatomy: Back and Core
- Biology 163. Plant Physiology and Biotechnology
- Biology 166. Animal Physiological Ecology
- Biology 167. Sensory Evolution
- Biology 185. Biochemical Physiology
- Biology 187c. Topics in Biology: Neural Organization of Behavior

Group 2:

- Biology 143. Genetics
- Biology 144. Drugs and Molecular Medicine
- Biology 148L. Neuroscience I: Cell, Molecular
- Biology 151L. Developmental Biology

- Biology 156L. Genomics and Bioinformatics
- Biology 157L. Cell Biology
- Biology 158. Cell Cycle and Diseases
- Biology 164. Virology
- Biology 168L. Microbiology
- Biology 170L. Molecular Biology
- Biology 171. Biology of Cancer
- Biology 177. Biochemistry
- Biology 181. Molecular Basis of Neurological Disorders
- Biology 182. Applied Phylogenetics
- Biology 187a. Topics in Biology: Epigenetics
- Biology 187b. Topics in Biology: Molecular Ecology
- Biology 187f. Topics in Biology: Advanced Genetics

Group 3:

- Biology 135. Field Biology
- Biology 138L. Applied Ecology Lab
- Biology 138. Applied Ecology
- Biology 145. Evolution
- Biology 146L. Ecology
- Biology 147. Biogeography
- Biology 154. Animal Behavior
- Biology 165. Advanced Topics in Environmental Biology
- Biology 169L. Marine Ecology
- Biology 176. Tropical Ecology
- Biology 187. Special Topics in Biology

Group 4:

- Biology 174L. Introduction to Biology Research Statistics
- Biology 175. Applied Biostatistics

- Students are strongly encouraged to pursue an in-depth research experience through either a study abroad program with a field biology component or an on-or-off-campus summer research project. With prior departmental approval students may count off-campus courses towards electives and/or research experiences towards thesis.

- A one or two semester thesis in Biology.

NOTES:

Students planning careers in biology should seriously consider taking additional upper division biology courses beyond the minimum required for graduation.

Pre-med and pre-vet students should plan to take two semesters of organic chemistry (Chem 116L and 117L) in their junior or senior year.

Students with a strong background in Chemistry (AP 4 or 5) should take the placement exam for the one-semester accelerated introductory chemistry course (Chem 29L) in place of the two-semester Chem 14L and Chem 15L sequence.

A Recommended **Minimum** Schedule:

Freshman	<u>FALL</u> Chem 14L Bio 43L <u>or</u> Math 30	<u>SPRING</u> Chem 15L Bio 44L
Sophomore	Bio 120 Bio 43L <u>or</u> Math 30 Physics 30L	Physics 31L UD Bio Elective
Junior	UD Bio elective	Off campus study (2 UD Bio electives recommended)
Senior	UD Bio elective Senior Thesis	UD Bio elective Senior Thesis

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PHYSICS MAJOR

Physics explores the fundamental principles governing the behavior of our universe, from the subatomic scale to the cosmological scale. These principles underlie most modern technologies, and have direct applications to biology, chemistry, neuroscience, engineering, environmental analysis, etc., making physics a highly versatile undergraduate major. Physics majors work closely with faculty as they develop a broad range of highly flexible analytical and quantitative model-building and problem-solving skills. Our program places particular curricular emphasis on computational/numerical modeling techniques, so that our majors are well versed in tackling complex problems which are not readily solved by traditional methods. Physics alumnae go on to a variety of positions, including industrial and academic research, biophysics, engineering, finance, law, medicine, mathematics. Course requirements for the physics major are kept relatively modest, allowing students with multiple interests to pursue double and dual majors and minors.

MAJOR REQUIREMENTS:

Math 30, 31, 32	Calculus I, II, III
Math 102	Differential Equations or equivalent
Physics 33L, 34L	Principles of Physics
Physics 35	Modern Physics with Computational Applications
Physics 100	Computational Physics & Engineering
Physics 101	Classical Mechanics with Computational Applications
Physics 102	Electromagnetism
Physics 108*	Programming for Science & Engineering
Physics 114**	Quantum Mechanics with Computational Applications
Physics 115**	Statistical Physics with Computational Applications
Bio/Phys/Chem 191 or 188L/190L or 189L/190L	One or two-semester thesis in Physics

RECOMMENDED:

Chemistry 14L, or Chemistry 40L	Basic Principles of Chemistry Introduction to Biological Chemistry
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*Or one computer science course chosen in consultation with the faculty advisor

** Course also offered at HMC and Pomona Colleges

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SCIENCE MANAGEMENT

This program is designed to provide students with a solid background in science, economics, and fundamental managerial skills. Majors complete a core program consisting of a minimum of fourteen courses in addition to a five-course, area of concentration in science. In addition to those listed, students have the option of creating their own track in consultation with the Science Management advisor.

Major Requirements

1. Core Program:

- Chemistry 14L-15L. *Basic Principles of Chemistry*, or
Chemistry 29L. *Accelerated General Chemistry*, or
Chemistry 40L-15L. *Introduction to Biological Chemistry*,
 - Biology 43L-44L. *Introductory Biology*, or
Biology 40L-44L. *Introduction to Biological Chemistry*,
- *Students who wish to specialize in the Physics sequence have the option of taking Physics 30L-31L, 33L-34L, in lieu of Biology for their Core Program.
- Mathematics 30. *Calculus I* or demonstrated competency (e.g., placement exam)
 - Psychology 37 (CMC). *Organizational Psychology*
 - Computer CS5 HM or CSCI051 PO. *Introduction to Computer Science*
 - Econ 52. *Principles of Microeconomics*
 - Econ 86 (CMC). *Accounting for Decision Making*
 - Econ 101. *Intermediate Microeconomics*
 - Econ 120. *Statistics* or other statistics course, preferably with R (e.g., BIOL175)
 - Econ 134 (CMC). *Corporate Finance* (students can also take Econ 165 CM for this requirement)
 - Econ 151 (CMC). *Strategic Cost Management*
 - A Course in Ethics (e.g., PHIL125 HM-01, CSCI181R JT-01, BIOL053 PO)
 - *Project Management Fundamentals*. This requirement can be met by taking one of the following:
 - E183 HM. *Management of Technical Enterprise* (offered in FA)
 - Econ 165 CM. *Industrial Organization* (offered annually; cannot be double-counted for the corporate finance requirement)
 - Econ 150 PO. *Industrial Organization* (offered in SP; note that course is impacted)
 - ALS400 KGI. *Team Master's Project* (taken in conjunction with a TMP senior thesis)
 - Senior Thesis. Majors must complete a thesis as the capstone requirement to the major. Options include either a 2-semester *Team Master's Project* (TMP) or a one- or two-semester thesis in Biology, Chemistry, or Physics (189L, 188L/190L, 189L/190L).

2. Areas of Concentration:

All majors must complete an area of concentration track with a **minimum of five courses:**

a. Chemistry Track

- Chemistry 116L-117L. *Organic Chemistry*
- Chemistry 126L or Chem127L. *Advanced Laboratory in Chemistry*
- 2 additional upper-division chemistry courses

b. Physics Track

- Mathematics 32. *Calculus III*
- Physics 35. *Modern Physics with Computational Applications*
- At least 3 additional upper-division physics courses from the following: Physics 101, 102, 114, and 115. Please note that Mathematics 111 (*Differential Equations*) is a prerequisite for most upper-division physics courses.

c. Biophysics Track

- Physics 30L-31L, 33L-34L
- Physics 35. *Modern Physics with Computational Applications*
- Mathematics 32. *Calculus III*
- Physics 178. *Biophysics*
- Physics 115. *Statistical Mechanics*

d. Biotechnology Track

- Chemistry 116L-117L. *Organic Chemistry*
- 3 additional upper-division biology classes (at least one with lab). Recommendations include: Biology 131L (*Vertebrate Phys.*), Biology 132L (*Comparative Phys.*), Biology 133L (*Dynamical Diseases: Intro. to Mathematical Phys.*), Biology 141L (*Vertebrate Anatomy*), Biology 143 (*Genetics*), Biology 150ALKS or 150 BLKS (*Functional Human Anatomy and Biomechanics*), Biology 156L (*Genomics and Bioinformatics*), Biology 157L (*Cell Biology*), Biology 158 KS (*Cell Cycle, Diseases, and Aging*), Biology 164 (*Virology*), Biology 170L (*Molecular Biology*), & Biology 177 (*Biochemistry*)

e. Neuroscience Track

- Neuro 95. *Foundations of Neuroscience* (or comparable equivalent)
- Biology 149. *Neuroscience 2*
- Biology 161L. *Neuroscience 1*
- 2 additional neuroscience-related courses

f. Environmental Management Track

At least 2 courses in this sequence must have an associated laboratory component

- Biology 138L or 139. *Applied Ecology and Conservation (with or without lab)*
- Biology 165. *Advanced Topics in Environmental Biology*
- Environmental Analysis 100L or 100. *Climate Change (with or without lab)*
- Chemistry 139. *Environmental Chemistry*
- 1 additional course in environmental analysis. Recommendations include: Biology 147 (*Biogeography*), Biology 146L (*Ecology*), Biology 135L (*Field Biology*), Biology 169L (*Marine Ecology*), Environmental Analysis 104 (*Oceanography*), Environmental Analysis 103 (*Soils and Society*), and Biology 176 (*Tropical Ecology*)

g. Public Health Track

Courses must be selected from 3 of the 5 fields listed below. Please note that some of these courses have prerequisites outside of the GE/Core program of this major.

- Science (e.g., Chemistry 116L-117L *Organic Chemistry* and/or Physics 30L-31L *Principles of Physics*)
- Economics (e.g., 109 CM, 129 PO, 187 CM, PHIL180 CM)
- Psychology (e.g., 81 CM, 103 PZ, 107 CM, 111 PZ, 155 CM, 176 PO, 185 CM, 152 SC 188 PZ, 193 PZ)
- Sociology (e.g., 86 PZ, 120 PZ, 170 PZ, ONT101 PZ, CHLT110 PZ, CHLT153 PZ, ANTH002 PZ/SC, PHIL155 SC)
- Government (e.g., 105 CM, 106 CM, 114 CM, POLI151 SC)