

REQUIREMENTS FOR MAJORS

BIOLOGY

BIOCHEMISTRY

BIOPHYSICS

CHEMISTRY

ENVIRONMENTAL ANALYSIS

HUMAN BIOLOGY

MANAGEMENT ENGINEERING

MOLECULAR BIOLOGY

NEUROSCIENCE

ORGANISMAL BIOLOGY

PHYSICS

SCIENCE MANAGEMENT

KECK SCIENCE DEPARTMENT

PITZER COLLEGE

2020-2021

Pitzer College

Keck Science Department

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 for the major:

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 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: Combined majors (PZ) in Biology need only 5 Biology Elective Courses (at least two with lab) and no Breadth courses.

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
Chemistry 14L, 15L, or Chemistry 29L, or Chemistry 40L and 15L, or Chemistry 42L	Cell Biology Molecular Biology Biochemistry
Chemistry 116L, 117L	Basic Principles of Chemistry Accelerated General Chemistry Introduction to Biological Chemistry Integrated Biology and Chemistry
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 Biology 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 a Combined Major 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

Environmental Analysis is an interdisciplinary major focusing on the interaction between human and non-human components of the biosphere. The major applies approaches in the social sciences, arts and humanities, and natural sciences to understanding and solving environmental problems. Environmental Analysis offers an integrated, unifying perspective on life, as well as a program for affecting positive change. The major prepares students for graduate work and careers in teaching, public policy and administration, law, environmental sciences, international affairs, environmental design, and the non-profit sector. Developing sustainable ways of living is one of the greatest challenges of our time. The Environmental Analysis Program combines the strengths of the five Claremont Colleges to provide robust interdisciplinary training for students interested in environmental issues. Resources for field research include the Pitzer in Costa Rica Program, the John R. Rodman Arboretum, the Bernard Biological Field Station, and numerous local partnerships.

The Environmental Analysis Program regards external study as a valuable, though not required, part of the curriculum, enabling students to secure deeper appreciation of the global dimensions of environmental challenges. Additionally, the Program encourages students to engage in internships and fieldwork that move them beyond the classroom and library to engage in research and action.

MAJOR REQUIREMENTS:

The Environmental Analysis major offers three Tracks: Environmental Science, Environmental Policy, and Environment & Society and Sustainability and the Built Environment. Below are the requirements for the *Environmental Analysis: Environmental Science* track. Students interested in the other tracks should see the major requirements in the Pitzer catalog.

The major consists of five sets of requirements:

- Core set of courses
- One natural science course
- Track with Course Plan
- Environmental Internship for the Environment & Society and Environmental Policy Tracks
- Capstone Seminar or Thesis depending upon Track

Environmental Science Track

Students considering an EA major/minor should discuss the eligibility of specific courses with their faculty advisor and with EA science faculty.

Introductory Core: EA 10, and either EA 20 PO or EA 86 PZ or POLI 136 PO

Introductory Biology: BIOL 43L, BIOL 44L or BIOL 040L and BIOL 044L, or BIOL 042L and BIOL 044L

Introductory Chemistry: CHEM 14L and CHEM 15L (or CHEM 029L), OR CHEM 040L and CHEM 015L, or CHEM 042L

One upper-division policy course

One introductory Earth science course (e.g., EA 55L KS or PO GEOL 020 or approved alternative)
Six upper-division EA-approved science courses selected in consultation with KSD Environmental Science faculty, including one or more in ecology (e.g., BIOL 135L KS, BIOL 138L/138 KS, 146L KS, BIOL 169L KS, and others) and one or more that emphasizes Earth science (e.g., EA 100L KS, EA 103 KS, EA 103L KS, EA 104 KS, and others). Three of the courses must have a laboratory requirement. These six courses may be cross-listed but normally may not double-count for another science major.
Senior Thesis/Capstone (two courses) to include ONE of the following TWO options: (i) a one-semester thesis in Environmental Analysis (EA 191), AND either Environmental Analysis Senior Seminar (PO EA 190) (generally offered in Spring) or Environmental Analysis Capstone (EA 150 PZ) (generally offered in Fall), or an alternative course approved by the Environmental Analysis science faculty. (ii) a two-semester thesis in Environmental Analysis, (EA 188L–190L or 189L–190L).
An environmentally-focused Off-Campus Study program is strongly recommended.

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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HUMAN BIOLOGY MAJOR

The Human Biology major studies the relevance of social conditions to the biological sciences. Biology courses in such areas as genetics, evolution, animal behavior, anatomy, and physiology complement courses in sociology, psychology, anthropology and public health to create a major that explores humans and humanity from a variety of perspectives. Human Biology majors complete the biology portion of the major and choose one of two options for the social science portion of the major. Option 1 exposes students to Anthropology, Sociology and Psychology and asks the student to choose one of those three fields as a focus. Option 2 is focused on cross-cultural health and healing from a wide range of viewpoints. Please note that this major does not include all of the courses required by medical schools or other pre-health programs. Students interested in pre-health programs should consult their advisor and the Keck Science pre-health advisor early in their college career to formulate a coherent four-year plan that meets their needs. This is a Pitzer major; CMC and Scripps students may choose this as an off-campus major.

MAJOR REQUIREMENTS:

Biology 43L, 44L, Introductory Biology, or Biology 40L, Introduction to Biological Chemistry and 44L, or Biology 42L, Integrated Biology and Chemistry and 44L
Chemistry 14L, 15L, Basic Principles of Chemistry, or 29L, Advanced General Chemistry, or Chemistry 40L, Introduction to Biological Chemistry and Chemistry 15L, or Chemistry 14L and Chemistry 42L, Integrated Biology and Chemistry
4 upper-division courses in Biology; at least 2 with lab;

Appropriate courses include, but are not limited to:

Genetics, Evolution, Biostatistics, Animal Behavior, Neuroscience 2: Systems, Cell Cycle Diseases and Aging, Drugs and Molecular Medicine, Biology of Cancer, Sensory Evolution, Genomics and Bioinformatics, Vertebrate Physiology, Vertebrate Anatomy, Dynamical Diseases: Introduction to Mathematical Physiology, Functional Human Anatomy and Biomechanics, Disease Ecology and Evolution

Option 1: Social Science

Introductory Courses: Students are required to take introductory courses in Anthropology, Psychology, and Sociology

- ANTH 001 PZ Introduction to Archaeology and Biological Anthropology
- PSYC 010 PZ Introduction to Psychology, or equivalent

- SOC 001 PZ Sociology and Its View of the World or equivalent
- Four upper division courses in one of the three areas:

Psychology (courses numbered over 90 including NEUR095L), Sociology (courses numbered over 100) or Anthropology (courses numbered over 100). It is recommended that one of these four courses is an appropriate methods course.

A course in statistics is strongly recommended and may count towards the relevant part of the major. For example, Applied Biostatistics as an upper division Biology course, Psychological Statistics as an upper division Psychology course, and Quantitative Research Methods in Sociology as an upper division Sociology course (students cannot count more than one statistics course towards the major).

A one or two semester Human Biology Thesis: BIOL 191 or BIOL 188L/190L or BIOL 189L/190L. Topic selected in consultation with the Biology faculty and/or Profs. Miller, Martins, Bonaparte. Some theses may require you to audit a thesis course in the appropriate discipline.

Option 2: Cross-Cultural Health and Healing

Seven courses with an emphasis on health and/or healing.

These may be drawn from Sociology, Anthropology, Psychology, Political Studies, and International and Intercultural Studies, among other disciplines that may be relevant. Necessary pre-requisite introductory courses can count among the seven courses, but four courses must be upper division. One of the courses must be an appropriate practicum or internship course. Students are encouraged to do independent fieldwork projects while studying abroad or through the Ontario Program.

A course in statistics is strongly recommended and may count towards the relevant part of the major. For example, Applied Biostatistics as a Biology course, Psychological Statistics as an upper division Psychology course, and Quantitative Research Methods in Sociology as an upper division Sociology course (students cannot count more than one statistics course towards the major).

A one or two semester Human Biology Thesis: BIOL 191KS One-Semester Thesis in Biology or BIOL 190L KS Senior Thesis Research Project in Biology, Second Semester or 188L/190L or 189L/190L – Topic selected in consultation with the Biology faculty and/or Profs. Miller, Snowiss, Martins, Bonaparte, Guillermo. Some theses may require you to audit a thesis course in the appropriate discipline.

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MANAGEMENT ENGINEERING

A five- year program, offered in conjunction with other institutions, allows students to receive both a Bachelor of Arts Degree in Management Engineering from Pitzer and a Bachelor of Science Degree in Engineering from the second institution. The first three years of study are undertaken on the Pitzer 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 Pitzer. Although formal programs exist with 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, at sgould@kecksci.claremont.edu.

AFTER GRADUATION

Most graduates go directly into industry, where they are welcomed. The Management-Engineering graduate has a combination of technical skill, economic knowledge, and breadth of understanding that constitutes the essentials of sound decision making. He/she can deal with engineering problems and understand at the same time the realities of the market place. Because industrial companies value these qualities highly, their initial salary offers to Management-Engineers have been generous.

MAJOR REQUIREMENTS:

Mathematics 30, 31, 32, 111 (CMC) or equivalent

Chemistry 14L or **Chemistry** 40L

Physics 33L, 34L, 35, 101 or 106L or 107

Economics 51, 52, 86 (CMC), and 1 advanced course

Organizational Studies/Social Science: any 2 of: Organizational Studies 100 or 105, 160 or 162, 135
Sociology 1

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

Biomedical engineers should take Biology 43L-44L.

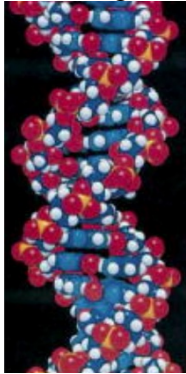
RECOMMENDED: Course in computing (CMC CS 60, HMC CS 5, or Physics 108); an introductory engineering course.

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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.

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

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

- General Physics for the Life Sciences: (Physics 30L or Physics 31L KS, or Principles of Physics 33L KS, or Physics 34L KS (Only one semester of physics may count)
- Mathematics: Math 031 PZ (Calculus II), Biology 175 KS (Applied Biostatistics), or Psychology 91 PZ, 103 SC or 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 042 SC, MATH 043 SC, or an approved equivalent course.
- Research Methods: Psychology 92 PZ, 104/104L SC, 110 CM, 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

Students studying abroad are allowed to use a maximum of two courses towards their course elective specialization.

4. Senior Thesis (one or two courses)

A one- or two-semester Senior Thesis on a topic related to the student's selected specialization.

Neuroscience (NEUR) 188L and 190L, two-semester thesis; or

Neuroscience (NEUR) 191, one-semester thesis

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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 alumni 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 111 (CMC), Math 102 (SCR)*	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	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 a faculty adviser.

**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*, or
both semesters of AISS
- Biology 43L-44L. *Introductory Biology*, or
Biology 40L-44L. *Introduction to Biological Chemistry*, or
both semesters of the AISS course

*Students who wish to specialize in the Physics sequence have the option of taking Physics 30L-31L, 33L-34L, or both semesters of the AISS course in lieu of Biology for their Core Program.

- Mathematics 30. *Calculus I* or demonstrated competency (e.g., placement exam)
- Computer Science CS5 HM or CSCI051 PO. *Introduction to Computer Science*
- Economics 52. *Principles of Microeconomics*
- Economics 86 (CMC). *Accounting for Decision Making*
 - Economics 105. *Microeconomic Theory*
- Economics 091. *Statistics* or other statistics course, preferably with R (e.g., BIOL175)
 - Economics 151 (CMC). *Strategic Cost Management*
 - Economics 134 (CMC). *Corporate Finance*
- Organizational Studies 135. *Organizational Behavior*
- A Course in Ethics (e.g., PHIL125 HM-01, CSCI181R JT-01, BIOL053 PO, PHIL198 CM, PHIL189 CM, ECON156 CM))
- *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. MATH 111 CM is equivalent to MATH 102 at Pitzer, Pomona or Scripps.

c. Biophysics Track

- Physics 30L-31L, 33L-34L, or both semesters of the AISS course
- 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)