Molecular Environmental Biology

Bachelor of Science (BS)

The Molecular Environmental Biology (MEB) major is designed to expose students to the organization and function of biological organisms. Molecular approaches are expected to play an increasing role in environmental problem-solving in the near future, and their success will depend upon a sound understanding of biological principles from molecular through ecological levels. The program trains students in the organization and function of biological organisms and their integration into the environment.

Declaring the Major

Advice on admission for freshmen and transfer students can be found on the Rausser College Admissions Guide (http://guide.berkeley.edu/archive/2023-24/undergraduate/colleges-schools/natural-resources/#admissionstext) page or the Rausser College Prospective Student website (https://nature.berkeley.edu/prospective-students/). Freshman students may apply directly to the major, or they may select the Rausser College of Natural Resource's undeclared option and declare the major by the end of their fourth semester. Transfer students apply directly to the major through the UC application.

Information for current Berkeley students who would like to declare the major after admission, including information on change of major or change of college, please see chapter 6 of the Rausser College of Natural Resources Undergraduate Student Handbook (https://nature.berkeley.edu/handbook/). (https://nature.berkeley.edu/handbook/) Students can meet with peer advisors or academic advisors for full guidance.

- There is a 3.0 GPA requirement to transfer into the Rausser College of Natural Resources from other colleges on campus.
- Required pre-requisite courses to declare the Molecular Environmental Biology major are: Reading & Composition Part A and Part B (http://guide.berkeley.edu/archive/2023-24/undergraduate/colleges-schools/natural-resources/reading-composition-requirement/), Chemistry 1A/1AL and 3A/3AL, one semester of Biology (1A/1AL or 1B), Math 1A or 16A or 10A, and a second quantitative course in either Math (1B, 16B, 10B) or Statistics (STAT 2, C8, 20, 131A, PB HLTH 141, 142, W142).
  - It is recommended that students complete the ESPM lower-division core courses prior to declaring.
- Undeclared students in Rausser College must declare a major by the end of their fourth semester. Failure to declare a major by junior standing will result in a registration block on further enrollment.
- Current UC Berkeley students who entered as freshmen are expected to be able to graduate in a total of 8 semesters (summers excluded). Exceptions are rarely granted. Students should be progressing in major requirements each semester.
- All major requirements must be taken for a letter grade and passed with a C- or better (including breadth). Please see the College Requirements page for any exceptions to this policy.
- Both halves of the Reading and Composition requirement must be completed by the end of the fourth semester.

Honors Program

Students with a grade point average (GPA) of 3.6 or higher may enroll in the Rausser College of Natural Resources Honors Program (ESPM H196) once they have reached upper-division standing. To fulfill the program requirements, students design, conduct, and report on an individual research project working with a faculty sponsor. For further information on registering for the Honors Symposium and on Honors requirements, please see the Rausser College of Natural Resources website (http://nature.berkeley.edu/site/honors_program.php).

Minor Program

There is no minor program in Molecular Environmental Biology.

Other Majors and Minors Offered by the Department of Environmental Science, Policy, and Management

Conservation and Resource Studies (http://guide.berkeley.edu/archive/2023-24/undergraduate/degree-programs/conservation-resource-studies/) (Major and Minor)
Environmental Sciences (http://guide.berkeley.edu/archive/2023-24/undergraduate/degree-programs/environmental-sciences/) (Major only)
Food Systems (https://nature.berkeley.edu/advising/minors/food-systems/) (Minor only)
Ecosystem Management and Forestry (http://guide.berkeley.edu/archive/2023-24/undergraduate/degree-programs/ecosystem-management-forestry/) (Major and Minor)
Geospatial Information Science and Technology (https://nature.berkeley.edu/advising/minors/gist/) (Minor only)
Society and Environment (http://guide.berkeley.edu/archive/2023-24/undergraduate/degree-programs/society-environment/) (Major only)

In addition to the University, campus, and college requirements, listed on the College Requirements tab, students must fulfill the below requirements specific to their major program. Please see the MEB Major Snapshot (https://bit.ly/MEB-Snapshot/) for an overview.

All students must complete Reading & Composition Parts A & B (http://guide.berkeley.edu/archive/2023-24/undergraduate/colleges-schools/natural-resources/reading-composition-requirement/) by the end of sophomore year.

The Rausser College of Natural Resources Undergraduate Handbook **(**https://nature.berkeley.edu/handbook/**) serves as a guide to the academic policies and information that students need in order to be successful while completing their coursework at Berkeley**

Structure of the MEB Major

The lower-division coursework provides a strong foundation in biological principles, and the upper-division areas introduce students to the organization and function of biological organisms at the molecular, cellular, organismal, and ecological levels. The major also offers specialization through six Areas of Concentration: (1) animal health and behavior, (2) biodiversity, (3) ecology, (4) environmental and human health, (5) global change biology, and (6) insect biology/arthropod science.

Lower Division Requirements

Breadth Requirement

Two courses. Select courses from "Breadth Requirements" Categories (https://classes.berkeley.edu).

One course (3-4 units) in *Arts & Literature*, *Historical Studies*, or *Philosophy & Values*

One course (3-4 units) in *Social & Behavioral Sciences* or *International Studies*

Core Requirements

ESPM Core (Environmental Science, Social Science), Quantitative Core (Calculus, Statistics), and Science Core (Chemistry, Biology, Physics)

ESPM Environmental Science Core (1 course)	
Select one of the following:	
ESPM 2	The Biosphere [3]
ESPM 6	Environmental Biology [3]
ESPM C10	Environmental Issues [4]
ESPM 15	Introduction to Environmental Sciences [3]
ESPM C46	Climate Change and the Future of California [4]
ESPM Social Science Core (1 course)	
Select one of the following:	
ESPM 5	FROM FARM TO TABLE: FOOD SYSTEMS IN A CHANGING WORLD [4]
ESPM C11	Americans and the Global Forest [4]
ESPM C22AC	Fire: Past, Present and Future Interactions with the People and Ecosystems of California [4]
ESPM 50AC	Introduction to Culture and Natural Resource Management [4]
ESPM C52	History of Native American Land, Colonialism, and Heritage Preservation [3]
ESPM 60	Environmental Policy, Administration, and Law [4]
Quantitative Core (2 courses)	
Select one of the following:	
MATH 16A	Analytic Geometry and Calculus [3]
MATH 1A	Calculus [4]
MATH 10A	Methods of Mathematics: Calculus, Statistics, and Combinatorics [4]
AND select one of the following:	
MATH 16B	Analytic Geometry and Calculus [3]
MATH 1B	Calculus [4]
MATH 10B	Methods of Mathematics: Calculus, Statistics, and Combinatorics [4]
STAT 2	Introduction to Statistics [4]
DATA C8	Foundations of Data Science [4]
STAT 20	Introduction to Probability and Statistics [4]
STAT C131A	Statistical Methods for Data Science [4]
PB HLTH 141	Introduction to Biostatistics [5]
PB HLTH 142	Introduction to Probability and Statistics in Biology and Public Health [4]
PB HLTH W142	Introduction to Probability and Statistics in Biology and Public Health [4]
Science Core	
Complete ALL of the following:	
CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory
CHEM 3A & 3AL	Chemical Structure and Reactivity and Organic Chemistry Laboratory
CHEM 3B & 3BL	Chemical Structure and Reactivity and Organic Chemistry Laboratory
BIOLOGY 1A & 1AL	General Biology Lecture and General Biology Laboratory
BIOLOGY 1B	General Biology Lecture and Laboratory [4]
PHYSICS 8A	Introductory Physics [4] [1]

[1] For pre-health students, PHYSICS 8B is required in addition to PHYSICS 8A.

Upper-division Requirements

Select two courses from Area A and two courses from Area B. Complete at least 12 units in one Area of Concentration. Complete two upper-division laboratory courses. Area A, Area B, and Area of Concentration courses may not overlap. Overlap is allowed between the lab requirement and Area requirements.

Area A: Genetics, Molecular, Cell, and Developmental Biology

Select two courses from the following list.

CHEM 135	Chemical Biology	3
ESPM 108B	Environmental Change Genetics (lab included)	3
INTEGBI 134L	Practical Genomics	4
INTEGBI 141	Human Genetics	3
INTEGBI 161	Population and Evolutionary Genetics	4
INTEGBI 162	Ecological Genetics	4
INTEGBI 164	Human Genetics and Genomics (lab included)	4
MCELLBI C100A/ CHEM C130	Biophysical Chemistry: Physical Principles and the Molecules of Life	4
MCELLBI 102	Survey of the Principles of Biochemistry and Molecular Biology	4
MCELLBI 104	Genetics, Genomics, and Cell Biology	4
MCELLBI 110	Molecular Biology: Macromolecular Synthesis and Cellular Function	4
MCELLBI C117	Advanced Plant Biochemistry	4
MCELLBI 130	Course Not Available	4
MCELLBI 133L	Physiology and Cell Biology Laboratory (lab included)	4
MCELLBI 137L	Physical Biology of the Cell (lab included)	4
MCELLBI 140	General Genetics	4
MCELLBI 141	Developmental Biology	4
PLANTBI C103	Bacterial Pathogenesis	3
PLANTBI/ INTEGBI C109	Evolution and Ecology of Development	3
PLANTBI/ MCELLBI C112	General Microbiology	4
PLANTBI C134	Genome Organization and Nuclear Dynamics	3
PLANTBI 135	Physiology and Biochemistry of Plants	3
PLANTBI C136	Advanced Plant Biochemistry	4

PLANTBI C148	Microbial Genomics and Genetics	4
PLANTBI 150	Plant Cell Biology	3
PLANTBI 160	Plant Molecular Genetics	3
PB HLTH 162A	Public Health Microbiology	4

Area B: Organismal Biology, Physiology, and Ecology

Select two courses from the following list.

ENE,RES 101	Ecology and Society	3
ESPM/INTEGBI C105	Natural History Museums and Biodiversity Science (lab included)	3
ESPM 106	American Wildlife: Management and Policy in the 21st Century	3
ESPM C107	Biology and Geomorphology of Tropical Islands	15
ESPM 108A	Trees: Taxonomy, Growth, and Structures (lab included)	3
ESPM 109A	Island and Coral Reef Resilience and Ecosystem Services	3
ESPM 111	Ecosystem Ecology	4
ESPM 112	Microbial Ecology	3
ESPM 113	Insect Ecology	3
ESPM 114	Wildlife Ecology	3
ESPM C115C/ INTEGBI C176L	Fish Ecology (lab included)	3
ESPM 116B	Grassland and Woodland Ecology (lab included)	4
ESPM C125/ GEOG C148/ INTEGBI C166	Biogeography (lab included)	4
ESPM 131	Soil Microbiology and Biogeochemistry	4
ESPM 132	Spider Biology (lab included)	4
ESPM 137	Landscape Ecology (lab included)	3
ESPM C138/ MCELLBI C114/ PLANTBI C114	Introduction to Comparative Virology	4
ESPM 140	General Entomology (lab included)	4
ESPM 142	Insect Behavior	3
ESPM 144	Insect Physiology	3
ESPM/INTEGBI C153	Ecology	3
INTEGBI 102LF	Introduction to California Plant Life with Laboratory	4
INTEGBI 103LF	Invertebrate Zoology with Laboratory	5
INTEGBI 104LF	Natural History of the Vertebrates with Laboratory	5
INTEGBI 132	Human Physiology	4
INTEGBI 140	Biology of Human Reproduction	4
INTEGBI 148	Comparative Animal Physiology	3
INTEGBI 150	Evolutionary Environmental Physiology	3
INTEGBI 151	Plant Physiological Ecology	4
INTEGBI 154	Plant Ecology	3
INTEGBI 157LF	Ecosystems of California (lab included)	4
INTEGBI C160	Evolution	4
INTEGBI 168L	Plants: Diversity and Evolution (lab included)	4
INTEGBI 181L	Paleobotany - The 500-Million Year History of a Greening Planet (lab included)	4
INTEGBI 184L	Morphology of the Vertebrate Skeleton with Laboratory	4
MCELLBI 136	Physiology	4
NUSCTX 103	Nutrient Function and Metabolism	4
PLANTBI/ INTEGBI C110L	Biology of Fungi with Laboratory	4
PLANTBI 113	California Mushrooms (lab included)	3
PLANTBI/ MCELLBI C116	Microbial Diversity	3
PLANTBI 120	Biology of Algae	2
PLANTBI 165	Plant-Microbe Interactions	3

Lab Requirement

Students are required to take two upper-division laboratory courses in the biological or environmental sciences. Lab courses should include at least three hours of laboratory or field work per week and they may be chosen from one of the following departments: ESPM, PLANTBI, NUSCTX, INTEGBI, MCELLBI (see full list of currently approved lab courses (https://tinyurl.com/MEB-upperdiv/)).

One upper-division laboratory may be completed with Summer Forestry Field Camp (https://forestrycamp.berkeley.edu/), the Fall Moorea Field Study course (http://www.moorea-ucb.org/) (ESPM C107/ IB 158LF), or the Spring Moorea Field Study Program (https://www.moorea.berkeley.edu/programs/field-courses/island-sustainability-program/) (ESPM 109A-E).

Independent study research may be used to satisfy one of the two lab requirements: 3-4 units of 199 courses in ESPM, PLANTBI, NUSCTX, INTEGBI, MCELLBI; or an H196 from ESPM, PLANTBI, or NUSCTX; or UGIS 192C courses. Consult with the major advisor for details.

Area of Concentration Requirement

Select at least 12 units from one of the concentrations below. Up to four independent study units may be applied to the concentration (199 courses in ESPM, PLANTBI, NUSCTX, INTEGBI, MCELLBI; H196 from ESPM, PLANTBI, or NUSCTX; or UGIS 192C).

Animal Health & Behavior

ESPM C103/ INTEGBI C156	Principles of Conservation Biology	4
ESPM 106	American Wildlife: Management and Policy in the 21st Century	3
ESPM C107	Biology and Geomorphology of Tropical Islands	15
ESPM 109B	Polynesian Culture and Society	3
ESPM 114	Wildlife Ecology	3
ESPM C126/ INTEGBI C144	Animal Behavior	4
ESPM 139A	Genetics of Amphibian Declines CURE	3
ESPM 142	Insect Behavior	4,3
ESPM C156/ INTEGBI C145	Animal Communication	3
ESPM 157	Data Science in Global Change Ecology (lab included)	4
ESPM 158	Biodiversity Conservation in Working Landscapes (lab included)	4
ESPM 186	Grassland and Woodland Management and Conservation	4

ESPM/PLANTBI C192	Molecular Approaches to Environmental Problem Solving	2
INTEGBI 104LF	Natural History of the Vertebrates with Laboratory	5
INTEGBI 114	Infectious Disease Dynamics	4
INTEGBI 118	Organismal Microbiomes and Host-Pathogen Interactions	4
INTEGBI 120	Introduction to Quantitative Methods In Biology (lab included)	4
INTEGBI C143A/ PSYCH C113	Biological Clocks: Physiology and Behavior	3
INTEGBI C143B/ PSYCH C116	Course Not Available	
INTEGBI 146LF	Behavioral Ecology with Laboratory	5
INTEGBI 148	Comparative Animal Physiology	3
INTEGBI 173LF	Mammalogy with Laboratory	5
INTEGBI 174LF	Ornithology with Laboratory	4
INTEGBI 175LF	Herpetology with Laboratory	4
INTEGBI 177LF	Ichthyology: An Introduction to the Scientific Process Through Research on Fishes (lab included)	4
INTEGBI 184L	Morphology of the Vertebrate Skeleton with Laboratory	4

Biodiversity

ENE,RES 101	Ecology and Society	3
ESPM C103/ INTEGBI C156	Principles of Conservation Biology	4
ESPM/INTEGBI C105	Natural History Museums and Biodiversity Science (lab included)	3
ESPM C107	Biology and Geomorphology of Tropical Islands	15
ESPM 106	American Wildlife: Management and Policy in the 21st Century	3
ESPM 108A	Trees: Taxonomy, Growth, and Structures (lab included)	3
ESPM 112	Microbial Ecology	3
ESPM 113	Insect Ecology	3
ESPM 114	Wildlife Ecology	3
ESPM C115C/ INTEGBI C176L	Fish Ecology (lab included)	3
ESPM C125/ GEOG C148/ INTEGBI C166	Biogeography (lab included)	4
ESPM C126/ INTEGBI C144	Animal Behavior	4
ESPM 131	Soil Microbiology and Biogeochemistry	4
ESPM 132	Spider Biology (lab included)	4
ESPM 140	General Entomology (lab included)	4
ESPM 142	Insect Behavior	3
ESPM 147	Field Entomology (“Ants,” “Beetles,” and “Spiders” (1 unit each) SP. All three courses must be completed to equal one “lab course”)	1
ESPM C156/ INTEGBI C145	Animal Communication	3
ESPM 157	Data Science in Global Change Ecology (lab included)	4
ESPM 174A	Applied Time Series Analysis for Ecology and Environmental Sciences	3
ESPM/PLANTBI C192	Molecular Approaches to Environmental Problem Solving	2
INTEGBI 102LF	Introduction to California Plant Life with Laboratory	4
INTEGBI 103LF	Invertebrate Zoology with Laboratory	5
INTEGBI 104LF	Natural History of the Vertebrates with Laboratory	5
INTEGBI 108	Marine Biology	4
INTEGBI C160	Evolution	4
INTEGBI 168L	Plants: Diversity and Evolution (lab included)	4
INTEGBI 173LF	Mammalogy with Laboratory	5
INTEGBI 174LF	Ornithology with Laboratory	4
INTEGBI 175LF	Herpetology with Laboratory	4
INTEGBI 177LF	Ichthyology: An Introduction to the Scientific Process Through Research on Fishes (lab included)	4
INTEGBI 183L	Course Not Available	
INTEGBI 184L	Morphology of the Vertebrate Skeleton with Laboratory	4
PLANTBI/ INTEGBI C110L	Biology of Fungi with Laboratory	4
PLANTBI 113	California Mushrooms (lab included)	3
PLANTBI/ MCELLBI C116	Microbial Diversity	3
PLANTBI 120	Biology of Algae	2
PLANTBI 120L	Laboratory for Biology of Algae	2

Ecology

ENE,RES 101	Ecology and Society	3
ESPM C103/ INTEGBI C156	Principles of Conservation Biology	4
ESPM 105A	Sierra Nevada Ecology (Summer Forestry Camp)	4
ESPM C107	Biology and Geomorphology of Tropical Islands	15
ESPM 111	Ecosystem Ecology	4
ESPM 112	Microbial Ecology	3
ESPM 112L	Microbial Metagenomic Data Analysis Lab	1
ESPM 113	Insect Ecology	3
ESPM 114	Wildlife Ecology	3
ESPM C115A/ INTEGBI C171	Freshwater Ecology	3
ESPM C115C/ INTEGBI C176L	Fish Ecology (lab included)	3
ESPM 116B	Grassland and Woodland Ecology (lab included)	4
ESPM 117	Urban Garden Ecosystems (lab included)	4
ESPM 118	Agricultural Ecology	4
ESPM C125/ GEOG C148/ INTEGBI C166	Biogeography (lab included)	4
ESPM C130/ CIV ENG C103N/ GEOG C136	Terrestrial Hydrology	4
ESPM 131	Soil Microbiology and Biogeochemistry	3
ESPM 134	Fire, Insects, and Diseases in Forest Ecosystems	3
ESPM 137	Landscape Ecology (lab included)	3

ESPM 139A	Genetics of Amphibian Declines CURE	3
ESPM 147	Field Entomology (“Ants,” “Beetles,” and “Spiders” (1 unit each) SP. All three courses must be completed to equal one “lab course”)	1
ESPM 152	Global Change Biology	3
ESPM/INTEGBI C153	Ecology	3
ESPM 157	Data Science in Global Change Ecology (lab included)	4
ESPM 173	Introduction to Ecological Data Analysis (lab included)	3
ESPM 174	Design and Analysis of Ecological Research (lab included)	4
ESPM 181A	Fire Ecology (lab included)	3
ESPM/PLANTBI C192	Molecular Approaches to Environmental Problem Solving	2
INTEGBI 102LF	Introduction to California Plant Life with Laboratory	4
INTEGBI 108	Marine Biology	4
INTEGBI 114	Infectious Disease Dynamics	4
INTEGBI 120	Introduction to Quantitative Methods In Biology	4
INTEGBI 151	Plant Physiological Ecology	4
INTEGBI 151L	Plant Physiological Ecology Laboratory	2
INTEGBI 154	Plant Ecology	3
INTEGBI 154L	Plant Ecology Laboratory	2
INTEGBI C160	Evolution	4
PLANTBI 180	Environmental Plant Biology	2

Environment & Human Health

ANTHRO 135	Paleoethnobotany: Archaeological Methods and Laboratory Techniques (lab included)	4
ESPM C107	Biology and Geomorphology of Tropical Islands	15
ESPM C126/ INTEGBI C144	Animal Behavior	4
ESPM C138/ MCELLBI C114/ PLANTBI C114	Introduction to Comparative Virology	4
ESPM 152	Global Change Biology	3
ESPM 157	Data Science in Global Change Ecology (lab included)	4
ESPM 162A	Health, Medicine, Society and Environment	4
ESPM C167/ PB HLTH C160	Environmental Health and Development	4
ESPM 189A	Urban Ecology and Evolution	4
ESPM/PLANTBI C192	Molecular Approaches to Environmental Problem Solving	2
INTEGBI 114	Infectious Disease Dynamics	4
INTEGBI 116L	Medical Parasitology (lab included)	4
INTEGBI 117	Medical Ethnobotany	2
INTEGBI 117LF	Medical Ethnobotany Laboratory	2
INTEGBI 118	Organismal Microbiomes and Host-Pathogen Interactions	4
INTEGBI 120	Introduction to Quantitative Methods In Biology (lab included)	4
INTEGBI 131	General Human Anatomy	3
INTEGBI 131L	General Human Anatomy Laboratory	3
INTEGBI 137	Human Endocrinology	4
INTEGBI 139	The Neurobiology of Stress	4
INTEGBI 140	Biology of Human Reproduction	4
INTEGBI C143A/ PSYCH C113	Biological Clocks: Physiology and Behavior	3
INTEGBI C143B/ PSYCH C116	Course Not Available	
INTEGBI C160	Evolution	4
MCELLBI C103	Bacterial Pathogenesis	3
MCELLBI 135A	Topics in Cell and Developmental Biology: Molecular Endocrinology	3
MCELLBI 150	Molecular Immunology	4
MCELLBI 160	Cellular and Molecular Neurobiology	4
MCELLBI 165	Course Not Available	
NUSCTX 103	Nutrient Function and Metabolism	4
NUSCTX 108A	Introduction and Application of Food Science	3
NUSCTX 160	Metabolic Bases of Human Health and Diseases	4
NUSCTX 166	Nutrition in the Community	3
PLANTBI/ MCELLBI C103	Bacterial Pathogenesis	3
PB HLTH 101	A Sustainable World: Challenges and Opportunities	3
PB HLTH 112	Global Health: A Multidisciplinary Examination	4
PB HLTH 116	Seminar on Social, Political, and Ethical Issues in Health and Medicine (P/NP okay for major)	3
PB HLTH 132	Artificial Intelligence for Health and Healthcare	3
PB HLTH 150B	Human Health and the Environment in a Changing World	3
PB HLTH 177	Course Not Available	3
PSYCH 110	Introduction to Biological Psychology	3

Global Change Biology

CIV ENG 107	Climate Change Mitigation	3
ENE,RES 101	Ecology and Society	3
ENE,RES 102	Quantitative Aspects of Global Environmental Problems	4
ENE,RES/ ENVECON/IAS C176	Climate Change Economics	4
ENVECON/ ECON C102	Natural Resource Economics	4
EPS 102	History and Evolution of Planet Earth	4
EPS 115	Stratigraphy and Earth History	4
EPS C181/ GEOG C139	Atmosphere, Ocean, and Climate Dynamics	3
ESPM C107	Biology and Geomorphology of Tropical Islands	15
ESPM 108B	Environmental Change Genetics (lab included)	3
ESPM/LD ARCH C110A	Ecological Analysis	4
ESPM C125/ GEOG C148/ INTEGBI C166	Biogeography (lab included)	4
ESPM 137	Landscape Ecology (lab included)	3
ESPM 152	Global Change Biology	3

ESPM 157	Data Science in Global Change Ecology (lab included)	4
ESPM C167/ PB HLTH C160	Environmental Health and Development	4
ESPM C170/ EPS C183	Carbon Cycle Dynamics	3
ESPM 174A	Applied Time Series Analysis for Ecology and Environmental Sciences	3
ESPM 189A	Urban Ecology and Evolution	4
ESPM/PLANTBI C192	Molecular Approaches to Environmental Problem Solving	2
GEOG 140A	Physical Landscapes: Process and Form	4
GEOG 142	Global Climate Variability and Change	4
GEOG 143	Global Change Biogeochemistry	3
GEOG 149B	Climate Impacts and Risk Analysis	3
GEOG/LD ARCH C188	Geographic Information Science	4
INTEGBI 159	The Living Planet: Impact of the Biosphere on the Earth System	3
PLANTBI 122	Bioenergy	2
PLANTBI 180	Environmental Plant Biology	2

Insect Biology/Arthropod Science

ESPM 140: General Entomology (4 units) is required for this concentration

ESPM 140	General Entomology (Required for this concentration. Lab included.)	4
ESPM/INTEGBI C105	Natural History Museums and Biodiversity Science (lab included)	3
ESPM C107	Biology and Geomorphology of Tropical Islands	15
ESPM 113	Insect Ecology	3
ESPM 132	Spider Biology (lab included)	4
ESPM 134	Fire, Insects, and Diseases in Forest Ecosystems	3
ESPM 142	Insect Behavior	3
ESPM 144	Insect Physiology	3
ESPM 147	Field Entomology (“Ants,” “Beetles,” and “Spiders” (1 unit each) SP. All three courses must be completed to equal one “lab course”)	1
ESPM 174A	Applied Time Series Analysis for Ecology and Environmental Sciences	3

Reading and Composition (http://guide.berkeley.edu/archive/2023-24/undergraduate/colleges-schools/natural-resources/reading-composition-requirement/)

In order to provide a solid foundation in reading, writing and critical thinking all majors in the College require two semesters of lower division work in composition. Students must complete a first-level reading and composition course by the end of their second semester and a second-level course by the end of their fourth semester.

Foreign Language (http://guide.berkeley.edu/archive/2023-24/undergraduate/colleges-schools/natural-resources/foreign-language-requirement/): **EEP Majors only**

The Foreign Language requirement is only required by Environmental Economics and Policy (EEP) majors. It may be satisfied by demonstrating proficiency in reading comprehension, writing, and conversation in a foreign language equivalent to the second semester college level, either by passing an exam or by completing approved course work.

Quantitative Reasoning (http://guide.berkeley.edu/archive/2023-24/undergraduate/colleges-schools/natural-resources/quantitative-reasoning-requirement/): **EEP Majors only**

The Quantitative Reasoning requirement is only required by Environmental Economics and Policy (EEP) majors. The requirement may be satisfied by exam or by taking an approved course.

Undergraduate Breadth

Undergraduate breadth provide Berkeley students with a rich and varied educational experience outside of their major program and many students complete their breadth courses in their first two years. Breadth courses are built into the Rausser College major requirements and each major requires a different number of breath courses and categories. The EEP major is the only college major that requires the entire 7 course breadth. Refer to the major snapshots on each Rausser College major page (https://nature.berkeley.edu/advising/majors-minors/) for additional information.

High School Exam Credit

Rausser College students may apply high school exam credit (Advanced Placement, International Baccalaureate, A-Level Exam) towards many College and Major Requirements. See AP Exam Equivalency Chart and Higher Level IB Exam Equivalency Chart (https://nature.berkeley.edu/advising/courses-grades/#AP%20Exam%20Equivalency%20Chat) in the Rausser College Student Handbook (https://nature.berkeley.edu/handbook/) for more information.

Unit Requirements

Students must complete at least 120 semester units of courses subject to certain guidelines:

- At least 36 units must be upper division courses, including a minimum of 15 units of upper division courses in the Rausser College.
- A maximum of 16 units of Special Studies coursework (courses numbered 97, 98, 99, 197, 198, or 199) is allowed towards the 120 units; a maximum of four is allowed in a given semester.
- A maximum of 4 units of Physical Education from any school attended will count towards the 120 units.
- Students may receive unit credit for courses graded P (including P/NP units taken through EAP) up to a limit of one-third of the total units taken and passed on the Berkeley campus at the time of graduation. Courses taken for P/NP in the Spring 2020 semester will not count toward this limit.

Semester Unit Minimum

All Rausser College students must enroll in at least 12 units each fall and spring semester.

Semester Unit Maximum

To request permission to take more than 20.5 units in a semester, please see the major adviser.

Semester Limit

Students admitted as freshmen must graduate within 8 fall/spring semesters at UC Berkeley. Students admitted as transfer students must graduate within 4 fall/spring semesters at UC Berkeley. Students who

go on EAP and UCDC can petition for additional semesters. Other UC-affiliated programs, such as the Gump Station in Moorea, may also be considered. Summer session, UC Extension and non-UC study abroad programs do not count towards this semester limit. Students approved for double majors or simultaneous degrees in two colleges may be granted an additional semester. Rausser College does not limit the number of total units a student can accrue.

Senior Residence Requirement

Once you achieve and exceed 90 units (senior status), you must complete at least 24 of the remaining 30 units in residence at the Rausser College of Natural Resources over at least 2 semesters. To count as residence, a semester must consist of at least 6 passed units taken while the student is a member of Rausser. At least one of the two terms must be a fall or spring semester. Senior residence terms do not need to be completed consecutively. All courses offered on campus for the fall, spring, and summer terms by Berkeley departments and programs and all Berkeley online ('W') courses count. Inter-campus Visitor, Education Abroad Program, UC Berkeley Washington Program, and UC Berkeley Extension units do not count toward this requirement. Students may use Summer Session to satisfy one semester of the Senior Residence Requirement, provided that 6 units of coursework are completed.

Modified Senior Residence Requirement

Participants in a fall, spring or summer UC Education Abroad Program (UCEAP), Berkeley Summer Abroad, or the UC Berkeley Washington Program may meet a modified Senior Residence Requirement by completing 24 of their final 60 semester units in residence (excluding UCEAP). At least 12 of these 24 units must be completed after senior status is reached. International travel study programs sponsored by Summer Sessions and education abroad programs offered outside of the UC system do not qualify for modified senior residence.

Most students automatically satisfy the residence requirement by attending classes here for four years. In general, there is no need to be concerned about this requirement, unless students go abroad for a semester or year or want to take courses at another institution or through University Extension during their senior year. In these cases, students should make an appointment to see an adviser to determine how they can meet the Senior Residence Requirement.

Grade Requirements

- A 2.0 UC GPA is required for graduation.
- A 2.0 average in all upper division courses required of the major program is required for graduation.
- A grade of at least C- is required in all courses for the major. Major and minor coursework taken in Spring 2020, Fall 2020, and Spring 2021 may be completed with P/NP grading option. See more details below.

Changes in Policies and Procedures during the COVID-19 Pandemic

Fall 2020, Spring 2021, SUMMER 2021

After much consultation across the colleges of UC Berkeley, and via our college Executive Committee, the following decisions have been made about the selection of the P/NP grade option (CPN) by undergraduate students during the Fall 2020 & Spring 2021 semesters for the Rausser College of Natural Resources.

- College Course Requirements: Reading and Composition, Quantitative Reasoning, and Foreign Language requirements normally satisfied with letter grades may be met with a passed (P) grade during the Fall 2020 semester. This does not include the system-wide Entry Level Writing requirement. College Writing R1A must be taken for a letter grade and completed with a C or better to fulfill the Entry Level Writing requirement.
- Requirements to Graduate: No changes in policy.
  - Rausser College students must have at least a 2.0 cumulative UC GPA to declare a Rausser College major.
  - Non-Rausser College students must have at least a 3.0 cumulative UC GPA to change to or add a Rausser College major.
  - Students must have at least a 2.0 cumulative UC GPA to graduate, both overall and in the upper-division courses required for the major.
- Academic Probation: The terms for Academic Probation (AP) have been modified.
  - Rausser CNR students currently in good standing who earn all “P” grades will remain in good standing.
  - Students currently in good standing who earn NP grades, Incompletes, or failing letter grades for more than 50% of units will be placed on academic probation and will be required to meet with their college advisor and complete an Academic Success Plan for the subsequent semester.
  - Students on AP must take all coursework for letter grades. Students on AP may be removed from probationary status with sufficient letter graded course work to raise their cumulative GPA above 2.0.
  - Students on Academic Probation who do not attain sufficient letter-graded coursework to be removed from AP (ie. enough grade points to raise cumulative GPA above 2.0 cumulative GPA) will remain on AP for the subsequent semesterand must complete an Academic Success Plan with their college advisor.
  - Students on Academic Probation who earn NP grades, Incompletes, or failing letter grades for more than 50% of units will be Subject to Dismissal and will be required to meet with their college advisor and complete an Academic Success Plan for the subsequent semester.
- Term Probation: Students in this category are placed on academic probation if their GPA falls below 1.5 in any fall or spring semester ("Term"). To get back into good standing, you must earn a UC Berkeley term GPA of 2.0 the following regular semester (fall/spring) and maintain an overall GPA of 2.0. If you fail to meet these conditions, you will be subject to dismissal from the University. For Fall 2020 & Spring 2021, the terms for Term Probation have been modified.
  - Rausser CNR students currently in good standing who earn all “P” grades will remain in good standing and will not be placed on Term Probation.
- Transferring Credit: If you are taking coursework through another institution in Fall 2020 & Spring 2021, P grades earned will be

accepted for all degree requirements. Note: This does not include the systemwide Entry Level Writing requirement. College Writing R1A must be taken for a letter grade and completed with a C or better to fulfill the Entry Level Writing requirement.

For additional information, please see Changes to Policies and Procedures for Fall 2020, Spring 2021, & Summer 2021 (https://nature.berkeley.edu/advising/AY-2020-2021-policy-adjustments/).

Spring 2020

In light of the substantial disruptions to instruction caused by the novel coronavirus emergency, the Berkeley Division of the Academic Senate made changes to grading options for the Spring 2020 semester. Rausser College adjusted college requirements as follows:

- College Course Requirements: All passing course work taken in Spring 2020 may be used for college requirements regardless of the grading option selected.
- Requirements to Graduate: To graduate, Rausser College students usually must have at least a 2.0 cumulative UC GPA to graduate, both overall and in the upper-division courses required for their major. For Spring 2020, students with at least a 1.9 cumulative GPA overall and in the upper-division courses required for their major to graduate will be considered as having met the requirement.
- Academic Probation: Recognizing the challenges to teaching and learning during the COVID-19 pandemic, Rausser College of Natural Resources will not be penalizing any students' academic progress for Spring 2020.
  - Students in good academic standing who earn all "P" grades will remain in good standing.
  - Students, who are in good standing, who earn NP grades, Incompletes, or failing grades for more than 50% of units will be required to meet with their college advisor and complete an Academic Success Plan for Fall 2020 by September 11, 2020, but will not be placed on Academic Probation.
  - Students on Academic Probation may be removed from probationary status with sufficient letter graded course work to raise their cumulative GPA above 2.0.
  - Students on Academic Probation who do not attain sufficient letter-graded coursework to be removed from AP (ie. enough grade points to raise cumulative GPA above 2.0 cumulative GPA) will remain on AP for Fall 2020 and must complete an Academic Success Plan with their college advisor by September 11, 2020.
- Term Probation: Recognizing the challenges to teaching and learning during the COVID-19 pandemic, Rausser College of Natural Resources will not be penalizing any students' academic progress for Spring 2020.
  - Students in good academic standing who earn all "P" grades will remain in good standing.
  - Students on Term Probation, but not AP, may be removed from probationary status with passing grades in at least 50% of units for Spring 2020.
  - Students on Term Probation at the start of Spring 2020 who earn NP, Incomplete, or failing grades for more than 50% of units must complete an Academic Success Plan with their college advisor by September 11, 2020 and will remain on Term Probation.
- Transferring Credit: If you are taking coursework through another institution in Spring 2020 (i.e. through Concurrent Enrollment or instead of being enrolled in Spring 2020 at UC Berkeley) and that institution has moved to a P/NP-default or P/NP-only grading model, P grades earned will be accepted for all degree requirements.

For additional information, please see Changes to Policies and Procedures for Spring 2020 (https://nature.berkeley.edu/advising/spring-2020-changing-policies-faq/).

These are sample program plans for completing the major in Molecular Environmental Biology. These plans assume that the student has completed the Entry Level Writing and American History and Institutions requirements prior to admission, and demonstrate completion of the major utilizing Fall and Spring semesters only. Most of the lower division major requirements and many of the upper division requirements are also offered during the summer terms. Students are strongly advised to work with peer and academic advisors to create a customized program plan specific to their situation. Your program plan will differ depending on previous credit received, your course schedule, and available offerings.

Students in Rausser College are required to take a minimum of 12 units each semester unless they are on an approved reduced course load. Students may need to take more than 12 units each semester, or may instead take course work in the summer, in order to reach the minimum 120 total semester units required for graduation depending on the number of units a student may have transferred in through exam credit or course work taken at other institutions. Please see the College Requirements tab on this page for additional details regarding unit requirements for graduation.

Sample plans below include:

- Sample 4-Year Plan (p. 8)
- Sample 4-Year Plan (CHEM 32) (p. 9)
- Sample 2-Year Plan for Transfer Students (p. 9)

Sample 4-Year Plan

Example of a 4-year plan beginning with CHEM 1A/1AL in Freshman year Fall semester.

				Freshman
	Fall Units		**Spring Units**	
CHEM 1A & 1AL	5	CHEM 3A & 3AL	5	
MATH 16A, 1A, or 10A	3-4	MATH or STAT[1]	3-4	
R&C/ ESPM core/ Breadth	3-4	R&C/ ESPM core/ Breadth	3-4	
Freshman Seminar/ Berkeley Connect	1-2	R&C/ ESPM core/ Breadth	3-4	
	12-15		**14-17**	
				Sophomore
	Fall Units		**Spring Units**	
CHEM 3B & 3BL	5	BIOLOGY 1A & 1AL	5	
BIOLOGY 1B	4	PHYSICS 8A[2]	4	
R&C/ ESPM core/ Breadth	3-4	R&C/ ESPM core/ Breadth	3-4	

Elective	3-4	Elective	3
	15-17		**15-16**
			Junior
	Fall Units		**Spring Units**
Area A or Area B	3-4	Area A or Area B	3-4
Area of Concentration	3-4	Area of Concentration	3-4
Elective	3-4	Elective	3-4
Elective	3-4	Elective	3-4
(include upper division lab)		(include upper division lab)	
	12-16		**12-16**
			Senior
	Fall Units		**Spring Units**
Area A or Area B	3-4	Area A or Area B	3-4
Area of Concentration	3-4	Area of Concentration (if needed)	3-4
Elective	3-4	Elective	3-4
Elective	3-4		
	12-16		**9-12**

Total Units: 101-125

[1] For the second quantitative course, students may either continue the calculus series (MATH 16B, 1B, or 10B) or instead take a course in statistics (STAT 2, C8, 20, 161A, PBHLTH 141, 142, or W142).

[2] PHYSICS 8A may be taken in a later semester.

Sample 4-Year Plan (CHEM 32)

Example of a 4-year plan beginning with CHEM 32 (Chemistry Prep) in Freshman year Fall semester, and then continuing with CHEM 1A/1AL in Freshman year Spring semester.

			Freshman
	Fall Units		**Spring Units**
CHEM 32	2	CHEM 1A & 1AL	5
MATH 16A, 1A, or 10A	3-4	MATH or STAT[1]	3-4
R&C/ ESPM core/ Breadth	3-4	R&C/ ESPM core/ Breadth	3-4
R&C/ ESPM core/ Breadth	3-4	Elective	3-4
Freshman Seminar/ Berkeley Connect	1		
	12-15		**14-17**
			Sophomore
	Fall Units		**Spring Units**
CHEM 3A & 3AL	5	CHEM 3B & 3BL	5
BIOLOGY 1B	4	PHYSICS 8A[2]	4
R&C/ ESPM core/ Breadth	3-4	R&C/ ESPM core/ Breadth	3-4
Elective	3-4	Elective	3
	15-17		**15-16**
			Junior
	Fall Units		**Spring Units**
BIOLOGY 1A & 1AL	5	Area A or Area B	3-4
Area B	3-4	Area of Concentration	3-4
Area of Concentration	3-4	Elective	3-4
Elective	1-3	Elective (include upper division lab)	3-4
	12-16		**12-16**
			Senior
	Fall Units		**Spring Units**
Area A or Area B	3-4	Area A or Area B	3-4
Area of Concentration	3-4	Area of Concentration (if needed)	3-4
Elective	3-4	Elective	3-4
Elective	3-4		
(include upper division lab)			
	12-16		**9-12**

Total Units: 101-125

[1] For the second quantitative course, students may either continue the calculus series (MATH 16B, 1B, or 10B) or instead take a course in statistics (STAT 2, C8, 20, 161A, PBHLTH 141, 142, or W142).

[2] PHYSICS 8A may be taken in a later semester.

Sample 2-Year Plan for Transfer Students

It is recommended that transfer students complete all lower division coursework before enrolling at Berkeley. See the MEB Transfer Admissions Guidelines (https://nature.berkeley.edu/sites/default/files/MEB%20Transfer%20Admissions%20Guidelines.pdf) for more information.

			Junior
	Fall Units		**Spring Units**
Area A or Area B	3-4	Area A or Area B	3-4
Area of Concentration	3-4	Area of Concentration	3-4
Elective/ ESPM SS Core or American Cultures (if needed)	4	Elective/ Physics 8A (if needed)	4
Transition Course/ Berkeley Connect	1-2	Elective	3-4
	11-14		**13-16**
			Senior
	Fall Units		**Spring Units**
Area A or Area B	3-4	Area A or Area B	3-4
Area of Concentration	3-4	Area of Concentration (if needed)	3-4
Elective	3-4	Elective	3-4
Elective	3-4	(include upper division lab)	
(include upper division lab)			
	12-16		**9-12**

Total Units: 45-58

Mission

Molecular Environmental Biology (MEB) focuses on biological organisms and the hierarchy of life, from molecules and genes through cells, organisms, communities, and ecosystems. The breadth of this biological science program provides an important perspective for students who have a passion for biology and are interested in the application of biological principles to understand how organisms function in their

environment. Also a pre-medical or pre-health science major, the discipline offers an array of six areas of concentration within biology: animal health and behavior, biodiversity, ecology, environmental and human health, global change biology, and insect biology/arthropod science.

Learning Goals for the Major

1. Holistic multidisciplinary thinking - understanding the “big picture"
    a. Interdisciplinarity & Cross-disciplinarity: The ability to understand and work across different disciplines (cross-disciplinarity) and to integrate the knowledge and methods from them (interdisciplinarity)
    b. Multiple processes: Recognition that biology and the environment involve multiple processes, as do solutions to modern problems
    c. Interconnectedness: Understanding that biology and the environment are interconnected at many spatial, temporal, and hierarchical levels
    d. Global and international approaches: Appreciating that the environment is necessarily global in nature and solutions to problems require international approaches
2. Training in the hierarchy of biology
    a. Fundamentals of Science: Training in the cores areas of physics, chemistry, biology, and mathematics
    b. Quantitative skills: Necessary tools for addressing biological problems
    c. Biochemistry: An understanding of the fundamentals of biological chemistry, including the properties of intermediary metabolites, the structure and function of biological macromolecules, and the logical basis of genetics and gene expression
    d. Molecular biology/Genetics: The molecular biology of bacterial, archaeal, and eukaryotic cells and their viruses, mechanisms of DNA replication, transcription, translation, nuclear and organellar genome structure and function, regulation of gene expression, heritability, measures of selection, etc.
    e. Cell and developmental biology: Cell structure and function, cellular metabolic processes, embryonic and post-embryonic development and growth
    f. Organismal physiology: Understanding of physiological function, whether microbial, animal, or plant, or comparison between different systems
    g. Organismal diversity: Emphasis on the nature of diversity whether plant, animal, fungus, protist, bacteria, or virus, the history of the lineages and life itself, global threats, how diversity is distributed, and the ecological and evolutionary processes that generate and maintain diversity.
    h. Ecology: The nature of interactions, biotic or abiotic, that dictate organismal distributions in space and time, energy flows, or population dynamics
    i. Laboratory experiences: Laboratory experiences allow students to gain hands-on experience in scientific approaches and methods
3. Analysis and application for students who choose the Animal Health & Behavior area of concentration
    a. Interaction of health and environment: Understanding how the environment, whether internal or external, affects organism health and behavior
    b. Expertise in health: Examination of the health of organisms from either physiological or environmental perspectives
    c. Epizootics: An appreciation of the potential for diseases in animal populations to spill over into humans as is the case in avian influenza or even the origins of HIV
4. Analysis and application for students who choose the Biodiversity area of concentration
    a. Biodiversity science: Detailed understanding of morphological and ecological diversity of a given organismic lineage
    b. Origins and evolution of life: Basic understanding of systematics and phylogenetics
    c. Quantifying biology: Knowledge of various sampling and species identification techniques to collect data
    d. Informatics: Proficiency in database development and management
5. Analysis and application for students who choose the Ecology area of concentration
    a. Principles of Ecology: Detailed understanding of ecological principles including energy flow, hydrologic, and mineral cycles, factors limiting species distribution and population size, and characteristics of species, populations, and communities
    b. Ecological interactions: Interactions relevant to different organismic groups.
    c. Biodiversity: Understanding of the biology of species, communities, and ecosystems.
6. Analysis and application for students who choose the Environment & Human Health area of concentration.
    a. Interaction of health and environment: Understanding of how the environment affects human health and well-being.
    b. Disease: Environmental epidemiology and the impacts of disease.
    c. Diet: Effects of nutrition and diet on human health.
7. Analysis and application for students who choose the Global Change Biology area of concentration.
    a. Global change biology expertise: How changes to the global environment impacts organisms and ecosystems, including impacts to spatial and temporal distributions of organisms, ecological processes, and ecosystem functions.

b. Global change and the environment: Global change biology in environmental science, including effects of human activities and impacts on human health and well-being.

c. Environmental problem solving: Conservation and mitigation strategies, ecological analysis, and natural resource economics

8. Analysis and application for students who choose the Insect Biology/ Arthropod Science area of concentration.

   a. Insects/arthropods and biodiversity science: Understanding of major groups of insects/arthropods, relationships, and diversity.

   b. Insects/arthropods and environmental science: Knowledge of the impacts of insects/arthropods (positive and negative) in the environment.

   c. Quantifying insects/arthropods and biology: Skills in collecting and identifying insects/arthropods

9. Basic skills in research, analysis, communication.

   a. Reading carefully: Ability to read for detail and comprehension.

   b. Writing accurately: Ability to write succinctly, clearly, and coherently.

   c. Thinking critically: Critical thinking through the synthesis of biological knowledge from courses and lab work.

   d. Using theoretical and empirical knowledge: Ability to synthesize and apply information obtained through theory and observations.

   e. Quantitative skills: Obtaining the quantitative skills necessary for the subdisciplines.

   f. Analysis: Ability to perceive, tackle, and solve problems in environmental science.

   g. Research experience: Research experience to practice scientific approaches and methods. Work with a faculty mentor while participating in an undergraduate research program or designing an individual research project. Share research results or work in progress in the form of a paper, report, research poster, or public presentation.

   h. Communication: Strong communication skills, both written and verbal, to prepare for independent research work or team projects.

10. Lifetime skills.

    a. Continuing appreciation for biological systems: To develop a passion for biology and its interconnections with the environment.

    b. Representing science: To become an advocate for the training and knowledge of science, particularly the biological disciplines.

    c. Problem-solving: To develop and practice scientific thinking and problem-solving skills, through data analysis, hypothesis testing, and critical reasoning, that translate to future careers inside and outside of biology.

Major Maps help undergraduate students discover academic, co-curricular, and discovery opportunities at UC Berkeley based on their intended major or field of interest. Developed by the Division of Undergraduate Education in collaboration with academic departments, these experience maps will help you:

- **Explore** your major and gain a better understanding of your field of study
- **Connect** with people and programs that inspire and sustain your creativity, drive, curiosity, and success
- **Discover** opportunities for independent inquiry, enterprise, and creative expression
- **Engage** locally and globally to broaden your perspectives and change the world
- **Reflect** on your academic career and prepare for life after Berkeley

Use the major map below as a guide to planning your undergraduate journey and designing your own unique Berkeley experience.

View the Molecular Environmental Biology Major Map PDF. **(**https://ue.berkeley.edu/sites/default/files/molecular_environmental_biology.pdf**)**

In the Rausser College of Natural Resources, we provide holistic, individual advising services to prospective and current students who are pursuing majors and minors in our college. We assist with a range of topics including course selection, academic decision-making, achieving personal and academic goals, and maximizing the Berkeley experience.

If you are looking to explore your options, or you are ready to declare a major, double major, or minor, contact the undergraduate advisor for your intended major. Visit our website (https://nature.berkeley.edu/advising/meet-cnr-advisors/) to explore all of our advising services.

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