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/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, or they may select the Rausser College of Natural Resources without declaring the major. 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/). 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/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


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/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.

**The curriculum has been revised effective Fall 2016. Students admitted prior to Fall 16 and following the previous curriculum should refer to the 15-16 (http://guide.berkeley.edu/archive/2015-16/undergraduate/degree-programs/molecular-environmental-biology/#majorrequirementstext) Guide.
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 52 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]

AND select one of the following:
- MATH 16B Analytic Geometry and Calculus [3]
- MATH 1B Calculus [4]
- STAT 2 Introduction to Statistics [4]
- STAT C8 Foundations of Data Science [4]
- PB HLTH 141 Introduction to Biostatistics [5]

Science Core

Complete ALL of the following:
- CHEM 1A General Chemistry & 1AL and General Chemistry Laboratory
- CHEM 3A Chemical Structure and Reactivity & 3AL and Organic Chemistry Laboratory
- CHEM 3B Chemical Structure and Reactivity & 3BL and Organic Chemistry Laboratory
- BIOLOGY 1A General Biology Lecture & 1AL 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 102 Survey of the Principles of Biochemistry and Molecular Biology [4]
- MCELLBI 104 Genetics, Genomics, and Cell Biology [4]
- MCELLBI 130 Cell and Systems Biology [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 C112 General Microbiology [4]
- PLANTBI C112 Chromosome Biology/Cytogenetics [3]
- PLANTBI 135 Physiology and Biochemistry of Plants [3]
- PLANTBI C148 Microbial Genomics and Genetics [4]
Area B: Organismal Biology, Physiology, and Ecology

Select two courses from the following list.

| ESPM/INTEGBI C105 | Natural History Museums and Biodiversity Science (lab included) | 3 |
| ESPM 107 | Biology and Geomorphology of Tropical Islands | 13 |
| 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/INTEGBI C145/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 | Survey of 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 160 | Evolution | 4 |
| INTEGBI 167 | Evolution and Earth History: From Genes to Fossils | 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 C107 | Biology and Geomorphology of Tropical Islands | 13 |
| ESPM 109B | Polynesian Culture and Society | 3 |
| ESPM 114 | Wildlife Ecology | 3 |
| ESPM C126/INTEGBI C144 | Animal Behavior | 4 |
| 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 |
**Molecular Environmental Biology**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESPM/PLANTBI C192</td>
<td>Molecular Approaches to Environmental Problem Solving</td>
<td>2</td>
</tr>
<tr>
<td>INTEGBI 104LF</td>
<td>Natural History of the Vertebrates with Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>INTEGBI 118</td>
<td>Organismal Microbiomes and Host-Pathogen Interactions</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 120</td>
<td>Introduction to Quantitative Methods in Biology (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 135</td>
<td>The Mechanics of Organisms</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI C135L/BIO ENG C136L/EL ENG C145O</td>
<td>Laboratory in the Mechanics of Organisms</td>
<td>3</td>
</tr>
<tr>
<td>INTEGBI C143/PSYCH C113</td>
<td>Biological Clocks: Physiology and Behavior</td>
<td>3</td>
</tr>
<tr>
<td>INTEGBI C143B/PSYCH C116</td>
<td>Hormones and Behavior</td>
<td>3</td>
</tr>
<tr>
<td>INTEGBI 146LF</td>
<td>Behavioral Ecology with Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>INTEGBI 148</td>
<td>Comparative Animal Physiology</td>
<td>3</td>
</tr>
<tr>
<td>INTEGBI 173LF</td>
<td>Mammalogy with Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>INTEGBI 174LF</td>
<td>Ornithology with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 175LF</td>
<td>Herpetology with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 177LF</td>
<td>Ichthyology: An Introduction to the Scientific Process Through Research on Fishes (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 184L</td>
<td>Morphology of the Vertebrate Skeleton with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PSYCH 121</td>
<td>Animal Cognition</td>
<td>3</td>
</tr>
</tbody>
</table>

### Biodiversity

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESPM C103/INTEGBI C105</td>
<td>Principles of Conservation Biology</td>
<td>4</td>
</tr>
<tr>
<td>ESPM/INTEGBI C105</td>
<td>Natural History Museums and Biodiversity Science (lab included)</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 108A</td>
<td>Trees: Taxonomy, Growth, and Structures (lab included)</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 112</td>
<td>Microbial Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 113</td>
<td>Insect Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 114</td>
<td>Wildlife Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM C115C/INTEGBI C176L</td>
<td>Fish Ecology (lab included)</td>
<td>3</td>
</tr>
<tr>
<td>ESPM C125/GEOG C148/INTEGBI C166</td>
<td>Biogeography (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>ESPM C126/INTEGBI C144</td>
<td>Animal Behavior</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 131</td>
<td>Soil Microbiology and Biogeochemistry</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 132</td>
<td>Spider Biology (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 140</td>
<td>General Entomology (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 142</td>
<td>Insect Behavior</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 147</td>
<td>Field Entomology (&quot;Ants,&quot; &quot;Beetles,&quot; and &quot;Spiders&quot; (1 unit each) SP. All three courses must be completed to equal one &quot;lab course&quot;)</td>
<td>1</td>
</tr>
<tr>
<td>ESPM C156/INTEGBI C145</td>
<td>Animal Communication</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 157</td>
<td>Data Science in Global Change Ecology (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 158</td>
<td>Biodiversity Conservation in Working Landscapes</td>
<td>4</td>
</tr>
<tr>
<td>ESPM/PLANTBI C192</td>
<td>Molecular Approaches to Environmental Problem Solving</td>
<td>2</td>
</tr>
<tr>
<td>INTEGBI 102LF</td>
<td>Introduction to California Plant Life with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 103LF</td>
<td>Invertebrate Zoology with Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>INTEGBI 104LF</td>
<td>Natural History of the Vertebrates with Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>INTEGBI 160</td>
<td>Evolution</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 168L</td>
<td>Plants: Diversity and Evolution (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 173LF</td>
<td>Mammalogy with Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>INTEGBI 174LF</td>
<td>Ornithology with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 175LF</td>
<td>Herpetology with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 177LF</td>
<td>Ichthyology: An Introduction to the Scientific Process Through Research on Fishes (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 183LF</td>
<td>Evolution of the Vertebrates with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>INTEGBI 184L</td>
<td>Morphology of the Vertebrate Skeleton with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PLANTBI/INTEGBI C110L</td>
<td>Biology of Fungi with Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PLANTBI 113</td>
<td>California Mushrooms (lab included)</td>
<td>3</td>
</tr>
<tr>
<td>PLANTBI/MCELLBI C116</td>
<td>Microbial Diversity</td>
<td>3</td>
</tr>
<tr>
<td>PLANTBI 120</td>
<td>Biology of Algae</td>
<td>2</td>
</tr>
<tr>
<td>PLANTBI 120L</td>
<td>Laboratory for Biology of Algae</td>
<td>2</td>
</tr>
</tbody>
</table>

### Ecology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESPM C103/INTEGBI C156</td>
<td>Principles of Conservation Biology</td>
<td>4</td>
</tr>
<tr>
<td>ESPM C104/ENVECON C115</td>
<td>Modeling and Management of Biological Resources</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 105A</td>
<td>Sierra Nevada Ecology (Summer Forestry Camp)</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 111</td>
<td>Ecosystem Ecology</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 112</td>
<td>Microbial Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 112L</td>
<td>Microbial Metagenomic Data Analysis Lab</td>
<td>1</td>
</tr>
<tr>
<td>ESPM 113</td>
<td>Insect Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 114</td>
<td>Wildlife Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM C115A/INTEGBI C171</td>
<td>Wildlife Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM C115C/INTEGBI C176L</td>
<td>Fish Ecology (lab included)</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 116B</td>
<td>Grassland and Woodland Ecology (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 117</td>
<td>Urban Garden Ecosystems (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 118</td>
<td>Agricultural Ecology</td>
<td>3</td>
</tr>
<tr>
<td>ESPM C125/GEOG C148/INTEGBI C166</td>
<td>Biogeography (lab included)</td>
<td>4</td>
</tr>
<tr>
<td>ESPM C130/CIV ENG C103N/GEOG C136</td>
<td>Terrestrial Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 131</td>
<td>Soil Microbiology and Biogeochemistry</td>
<td>4</td>
</tr>
<tr>
<td>ESPM 134</td>
<td>Fire, Insects, and Diseases in Forest Ecosystems</td>
<td>3</td>
</tr>
<tr>
<td>ESPM 137</td>
<td>Landscape Ecology (lab included)</td>
<td>3</td>
</tr>
</tbody>
</table>
Environment & Human Health

ANTHRO 135 Paleonthenobotany: Archaeological Methods and Laboratory Techniques (lab included) 4

ESPM C126/ INTEGBI C144 Animal Behavior 4

ESPM C138/ MCELLBI C114/ PLANTBI C114 Introduction to Comparative Virology 4

ESPM C148/ NUSCTX C114 Pesticide Chemistry and Toxicology 3

ESPM 152 Global Change Biology 3

ESPM 157 Data Science in Global Change Ecology (lab included) 4

ESPM 158 Biodiversity Conservation in Working Landscapes (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 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 160 Evolution 4

PLANTBI 180 Environmental Plant Biology 2

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 Atmospheric Physics and Dynamics 3

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
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/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/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 breadth 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


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 semester and 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.

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.

<table>
<thead>
<tr>
<th></th>
<th>Fall Units</th>
<th>Spring Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1A &amp; 1AL</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>MATH 16A, 1A, or 10A</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td>R&amp;C/ESPM core/Breadth</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td>Freshman Seminar/BC</td>
<td>1-2</td>
<td>3-4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Freshman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>12-15</td>
</tr>
<tr>
<td></td>
<td>14-17</td>
</tr>
</tbody>
</table>
### 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.

<table>
<thead>
<tr>
<th>Freshman</th>
<th>Sophomore</th>
<th>Junior</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall Units</strong></td>
<td><strong>Spring Units</strong></td>
<td><strong>Fall Units</strong></td>
</tr>
<tr>
<td>CHEM 32</td>
<td>2 CHEM 1A &amp; 1AL</td>
<td>5 Area A or Area B</td>
</tr>
<tr>
<td>MATH 16A, 1A, or 10A</td>
<td>3-4 MATH or STAT</td>
<td>Area B</td>
</tr>
<tr>
<td>R&amp;C/ ESPM core/ Breadth</td>
<td>3-4 R&amp;C/ ESPM core/ Breadth</td>
<td>Area of Concentration</td>
</tr>
<tr>
<td>R&amp;C/ ESPM core/ Breadth</td>
<td>3-4 Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Freshman Seminar/ Berkeley Connect</td>
<td>1</td>
<td>(include upper division lab)</td>
</tr>
<tr>
<td><strong>Total Units:</strong> 12-16</td>
<td></td>
<td><strong>Total Units:</strong> 101-125</td>
</tr>
</tbody>
</table>

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](https://nature.berkeley.edu/sites/default/files/MEB%20Transfer%20Admissions%20Guidelines.pdf)) for more information.
**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.

6. Analysis and application for students who choose the Environment & Human Health area of concentration.
   b. Disease: Environmental epidemiology and the impacts of disease.
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.

**Undergraduate Advisors, Molecular Environmental Biology**

meb.ugrad@berkeley.edu
260 Mulford Hall