BIOLOGY — PH.D.

Program director
Stephen G. Dunbar

Learning outcomes
• Demonstrate advanced breadth and depth of biological knowledge.
• Demonstrate the ability to plan and carry out independent research.
• Demonstrate effective writing and oral communication skills, including the ability to publish research findings.
• Demonstrate the ability to analyze and synthesize previous knowledge.
• Demonstrate a professional aptitude and attitude.
• Demonstrate critical evaluation skills in relating faith and science and public interest issues.
• Demonstrate skills, knowledge, and techniques that provide evidence of the ability to be ethical, independent, and engaged contributors to scientific and social communities.

General requirements
Seminar attendance requirements
All graduate students in residence must register for and attend Seminars (BIOL 607) each quarter at Loma Linda University.

Teaching experience
Teaching is recommended for at least one quarter. This experience may be obtained through laboratory teaching, or it may include presenting lectures for a course in consultation with the student’s major professor and the course instructor.

Research proposal
A written research proposal and oral defense of the student's proposed research should be completed early in the Spring Quarter.

Comprehensive
A written and oral comprehensive is required of the student after the first summer of research. The student is required to provide a written report in the form of a publishable manuscript and to orally defend the previous research in front of his or her research committee by the end of the Winter Quarter following the first summer of research.

Dissertation
The written dissertation must demonstrate the completion of significant, original research; and must be written in publishable paper format. At least one manuscript from the dissertation must be submitted for publication before the Ph.D. degree is granted.

Professional development
Ph.D. degree students are expected to publish papers, present papers at scientific meetings, and submit research grant proposals.

Registration and tuition after normative time
The program design is for Ph.D. degree students to complete their studies in the normative time of four years. In certain circumstances, students may require more time for completion. Students are required to be registered every quarter until the dissertation is completed, including defense. For details, see the continuous enrollment and personal leave of absence policies listed in the Academic Policies and Information (http://llucatalog.llu.edu/about-university/academic-policies-information) section of this Catalog. Students who are past the normative time for completing their degree must register for 2 units without a tuition waiver each quarter until they complete their degree. After their normative time, students may request a one-year grace period that must be approved by the department faculty.

Admissions
In addition to Loma Linda University (http://llucatalog.llu.edu/about-university/admission-policies-information/#admissionrequirementstext) admission requirements, the applicant must also complete the following requirements:
• Expected undergraduate preparation includes a bachelor’s degree with a biology major (M.S. degree recommended) from an accredited college or university.
• an acceptable score on the general GRE examination (the subject GRE is not required).
• Recommended G.P.A. in a previous M.S. degree program is at least 3.5.
• Complete the following corequisite courses:
  • Precalculus (required)
  • Calculus (recommended)
  • Statistics (one course)
  • General biology (one year)
  • Genetics (one course)
  • General chemistry (one year)
  • Organic chemistry (one year)
  • Biochemistry (recommended)
  • General physics (one year)
• Some of these courses may be taken during residence at this University, with the approval of the EBS admissions committee.

Application
Applications are accepted at any time. Review of applications begins in February for Autumn Quarter admission. Research assistantships are competitively awarded.

It is also recommended that applicants contact the department at <ebs@llu.edu>.

Required courses

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOL 502</td>
<td>Orientation to Graduate Biology (Orientation to Graduate Biology)</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 545</td>
<td>Genetics and Speciation</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 558</td>
<td>Philosophy of Science</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 607</td>
<td>Seminar in Biology</td>
<td>6</td>
</tr>
<tr>
<td>BIOL 616</td>
<td>Research and Experimental Design</td>
<td>2</td>
</tr>
</tbody>
</table>

All values below are in quarter units.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 617</td>
<td>Proposal Writing and Grantsmanship</td>
<td>2</td>
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</tbody>
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Select course(s) from each of the following areas

### Biological systems

- BIOL 517: Ecological Physiology
- BIOL 555: Molecular Genetics
- MICR 540: Physiology and Molecular Genetics of Microbes
- MICR 570: Mechanisms of Microbial Pathogenesis

### Ecology

- BIOL 444: Paleobotany
- BIOL 505: Marine Biology
- BIOL 515: Biogeography
- BIOL 539: Behavioral Ecology
- BIOL 546: Techniques in Vertebrate Ecology
- BIOL 549: Biodiversity and Conservation

### Organismal biology

- BIOL 409: Mammalogy
- BIOL 426: Invertebrate Paleontology
- BIOL 427: Vertebrate Paleontology
- BIOL 444: Paleobotany
- BIOL 504: Biology of Marine Invertebrates
- BIOL 539: Behavioral Ecology
- GEOL 545: Taphonomy

### Religion

Select one course with the RELT prefix:

- RELT 527: The Bible and Ecology
- RELT 558: Old Testament Thought
- RELT 559: New Testament Thought
- RELT 560: Jesus the Revealer: The Message of the Gospel of John
- RELT 564: Apostle of Hope: The Life, Letters, and Legacy of Paul

### Electives

Additional courses required by the student’s guidance committee to complete the total units required for the degree

- ANAT 516: Neuroscience GS
- ANAT 542: Cell Structure and Function GS
- BCHM 515: Introduction to Bioinformatics

### Research

Typically research units will be graded each quarter and can be repeated for additional credit

- BIOL 699: Dissertation Research (21+)

Total Units: 65

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1. BIOL 559 Philosophy of Science and Origins required for students who have taken BIOL 475 Philosophy of Science and Origins or equivalent

2. Each quarter in residence; 0.5 unit per quarter (Total units required may very depending on the number of quarters a student is on campus.)

3. In addition to this list, courses may also be chosen from unused courses listed above for biological systems, ecology, and organismal biology. When choosing elective, keep in mind that a maximum of 12 units below the 500 level may be applied to the 65 units for the Ph.D. degree.

### Noncourse requirements

#### Comprehensive examination

An oral comprehensive examination is given in connection with a written and oral presentation of an initial research project approved by the student’s guidance committee.

The purpose is to measure the student’s knowledge of his/her field of study; and his/her ability to find, understand, and synthesize the research literature on a topic, and to conduct original research. The oral examination covers the student’s field of study, as well as defending the research. The comprehensive exam will take place during the Autumn Quarter of the second year, after the first summer of research.

#### Advancement to candidacy

Students may apply for advancement to candidacy after:

- Completing all deficiencies and corequisites.
- Passing the comprehensive examinations.
- Selecting a research committee.
- Completing an approved written and oral research proposal and budget presentation for the research committee.
- Being recommended by the department faculty.

#### Defense of dissertation

An oral dissertation presentation and defense are required.

#### Grade requirement for graduation

All courses applied toward a graduate degree must have a grade of B or higher.

#### Normal time to complete the program

4 years based on full-time enrollment; part time permitted.