The Department of Earth and Biological Sciences (EBS) offers a program leading to the Bachelor of Science degree in environmental sciences (ENVS). This program builds upon a strong interdisciplinary breadth in natural, physical, and earth systems sciences to help understand the effect of human activities on environmental sustainability and management. In addition, since understanding the environment has become highly dependent on advanced technology, students will learn to use marketable geospatial applications, such as: geographic information systems (GIS), remote sensing, computer systems modeling, and global positioning systems (GPS). These tools will help students address environmental problems, such as: climate change, biodiversity decline, groundwater and soil contamination, use of natural resources, waste management, sustainable development, and air and noise pollution. Students have a choice of advanced expertise in conservation biology and biodiversity or environmental geology. Lastly, this program will encourage students to develop critical-thinking skills, healthy lifestyles, and service-oriented attitudes that are necessary to develop effective and ethical solutions to environmental problems on a local and global scale.

Learning outcomes

- Demonstrate breadth and depth of knowledge of earth's environment by understanding the dynamic and interdependent nature of each of earth's component systems (atmosphere, hydrosphere, biosphere, and geosphere).
- Demonstrate the ability to critically evaluate the relation of science and faith within an environmental context.
- Demonstrate written, technical, oral, and problem-solving skills necessary to collect, analyze, and share environmental data with scientific and public communities.
- Demonstrate awareness of the professional and academic opportunities in the environmental science field, as well as knowledge of concurrent environmental science research.
- Obtain an understanding of the human and natural causes to some of earth's environmental problems and learn how the environmental scientist addresses them.

Employment opportunities

Career options in the field of environmental sciences are diverse and abundant. The Environmental Sciences Program prepares students for entry-level jobs in environmental sciences or GIS fields. Graduates may pursue jobs in the public sector through local, state, and federal agencies such as U.S. Fish and Wildlife Service, U.S. Geological Survey, and Department of Fish and Game. In the private sector, graduates may seek jobs in environmental consulting firms, foundations, and organizations. Some examples of career paths that environmental science graduates pursue include environmental engineering, science, and social policy; a wide variety of natural resources management fields, such as soil science, forestry, agriculture, watershed science, range management, wildlife conservation, recreation resources, land management, and ecology; landscape architecture, conservation science, geographic information science (GIS), climatology, diverse health sciences; as well as public policy, law, or planning careers.

Environmental scientists may also become involved through employment or volunteering with nonprofit organizations such as Adventist Development and Relief Agency (ADRA) International; and help world populations learn how to use the earth's resources to their advantage in a sustainable manner.

Preparation for teaching

In addition to the environmental sciences major, a student preparing to teach at the elementary or secondary level will need to complete the requirements for a teaching credential. The student should consult the undergraduate program director for further information. General elective units can be used for education courses.

Preparation for advanced programs

Because of the strong foundation in the natural and physical sciences acquired in the Environmental Sciences Program, students have the option of applying to a variety of graduate programs; as well as medical, dental, and engineering programs. In most cases, these programs require full-year courses in general biology, general chemistry, general physics, and organic chemistry. One or more courses in calculus may also be required. Students are strongly encouraged to contact the prehealth or graduate program of their choice early in their studies to ensure they meet specific course requirements.

Environmental internship

The Environmental Sciences Program offers students the opportunity to engage in "hands-on" application of fundamentals learned in course work by enrolling in ENVS 487 Internship in Environmental Sciences. With the supervision of a faculty advisor, students will develop an academic component of the internship and will be permitted to earn up to 8 units of general elective credit towards the B.S. degree. All internship appointments are subject to Environmental Sciences Program director approval.

Undergraduate research

Following approval of an academic advisor and research professor, students interested in field research may gain training and experience in one of the three concentration areas offered by the program. Under the supervision of a research professor, students will develop a project within the context of environmental conservation, health, or sustainability in an effort to find new solutions to environmental problems.

Honors program

Students who have a G.P.A. of 3.0 or above, a sponsoring faculty member, and an approved research proposal may apply to be accepted in the environmental sciences honors program. The honors student must register for at least two units of undergraduate research, conduct original research under a faculty member’s direction, submit a written undergraduate thesis, and give a public oral presentation of his/her research.

Required units and residence requirement

All unit requirements listed are quarter units. Minimum requirements include one year of full-time residence in Loma Linda University, completing 32 of the last 46 units; or a minimum of 45 total units of course work for the degree at Loma Linda University. If the student has attended an institution that does not grant bachelor's degrees, a
Scholarships and discounts available to eligible undergraduate students in the Department of Earth and Biological Sciences include:

- Academic scholarships based on test results
  a. American College Test (ACT) score of 30 or above: $1,600 (or 16 percent of tuition)—for a student who maintains a cumulative G.P.A. of at least 3.5, renewable for successive years.
  b. Scholastic Aptitude Test (SAT): Student must maintain a 3.5 cumulative G.P.A., renewable for successive years. If a student qualifies for both an ACT and an SAT scholarship, the scholarship with the largest dollar value will apply.
    - National Merit Finalist Scholarship covers 100 percent of tuition.
    - National Merit Semifinalist Scholarship covers 34 percent of tuition.
    - National Merit Commended Scholarship covers 20 percent of tuition.
- Renewable G.P.A. scholarships (eligibility based on G.P.A. at the end of previous academic year). If a student is eligible for a National Merit Scholarship and/or an ACT scholarship, as well as a G.P.A. scholarship, the scholarship with the largest dollar value will apply—
  - G.P.A. between 3.75 and 4.00, $1,480 per year (or 15 percent of tuition).
  - G.P.A. between 3.50 and 3.74, $1,180 per year (or 12 percent of tuition).
  - G.P.A. between 3.25 and 3.49, $900 per year (or 9 percent of tuition).
- Scholarships and discounts available to eligible undergraduate students in the Department of Earth and Biological Sciences include:
  - B.S.: $290/unit; 12-18 units—$3,480 per quarter.

Please note: Grades of C- and below are not accepted for credit.

Financial aid

The following tuition rate for Geology or Environmental Sciences programs apply—B.S.: $290/unit; 12-18 units—$3,480 per quarter.

Admissions

The student in the B.S. degree in Environmental Sciences (ENVS) Program will generally take the first two years of required corequisite course work (96-105 units) at any accredited community college or university, and the last two years of the ENVS curriculum at Loma Linda University. Students may obtain early entrance with the approval of the Earth and Biological Sciences Department after completing at least 48 quarter units of corequisites at a college of their choice. Students accepted early will concurrently take course work at a nearby community college in order to complete their outstanding corequisite requirements.

In addition to Loma Linda University admissions requirements (http://llucatalog.llu.edu/about-university/admission-policies-information/#admissionrequirementstext), the applicant must also complete the following requirements:

- have a 2.5 G.P.A.
- three letters of recommendation from faculty members at the institutions previously attended.
- course corequisites listed below

Course corequisites

Domain 1: Religion and Humanities (20 quarter units minimum)

Humanities (12 quarter units minimum)

Choose courses from three of the following areas: civilization/history, fine arts (art history and music history), literature, philosophy, and performing/visual arts (not to exceed 4 quarter units).

Religion

An applicant who has attended an Adventist college or university is required to have taken four quarter units of religion from an Adventist institution for each year of attendance at an Adventist college or university. Up to 8 quarter credits may apply towards the 20 units needed in Domain 1. If the applicant has not attended an Adventist institution, there are no religion units required. In either case, however, the applicant must have completed 20 quarter/14 semester units in Domain 1: Humanities and Religion.

Domain 2: Scientific Inquiry and Analysis (43 quarter units)

Natural Sciences (31 units)

- College algebra (4 units)
- Statistics (3 units) offered at LLU
- Two of the following full-year sequences:
  - General biology with laboratory (12 units)
  - General chemistry with laboratory (12 units)
  - General physics with laboratory (12 units)

Social Sciences (12 units minimum)

- One course dealing with human diversity (e.g., cultural anthropology)
- Choose remaining units from the following areas: geography, economics, political science, psychology, sociology, etc.

Domain 3: Communication (9-13 quarter units)

- English composition (complete sequence)
- Elective areas may include courses in computer information systems, critical thinking, and public speaking
Domain 4: Health and Wellness (2-6 quarter units)
- Two activity courses in physical education
- Personal health or nutrition

Domain 5: Electives
Electives from the previous four domains may be selected to complete the general education minimum requirements of 68 quarter units. For total unit requirements for graduation, see LLU General Education Requirements (http://llucatalog.llu.edu/about-university/division-general-studies/#courserequirementstext).

Please note: Grades of C- and below are not accepted for credit.

Program requirements

Required core courses
- BIOL 449 Biodiversity and Conservation 3
- ENVH 414 Introduction to Environmental Health 3
- ENVS 401 Earth System Science and Global Change 4
- ENVS 455 Environmental Law and Regulation 4
- ENVS 485 Seminar in Environmental Sciences 1 0.5
- GEOL 475 Philosophy of Science and Origins 4

Concentration
Select a concentration in Conservation Biology and Biodiversity OR Environmental Geology (see descriptions below)

Required environmental sciences electives
Select from any of the environmental sciences concentration areas or the approved ENVS electives. A minimum of one course from each non-concentration area is required.

Religion
- REL 4 Upper-division Religion 2 6-10
Select one course of the following: 2
  - RELT 406 Adventist Beliefs and Life
  - RELT 423 Loma Linda Perspectives
  - RELT 436 Adventist Heritage and Health
  - RELT 437 Current Issues in Adventism

General electives
Any undergraduate courses taught at Loma Linda University or other regionally accredited college to meet the 192-unit total requirement

  1 All ENVS students are required to register and attend seminar every quarter while enrolled. Typically seminar units will add up to 3 units at the completion of the ENVS program.

  2 Total units required will be prorated based on total program units completed at LLU and other SDA colleges/universities.

Concentrations

Conservation biology and biodiversity
One year each of general biology and general chemistry are required for this concentration.

This concentration is suitable for students wishing to empirically analyze the health of an ecosystem, including population and distribution of plants and animals and environmental degradation and its causes, with the goal of proposing methods of improving the health of the ecosystem. Graduates in this track normally work closely with government, conservation agencies, and industry to develop land and water management plans and educate the public about threats to the health of ecosystems. This concentration is also appropriate as background for graduate study in such disciplines as biology, ecology, forestry, and environmental health. However, one year of organic chemistry and one year of physics is required of most graduate programs listed above.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOL 406</td>
<td>Marine Biology</td>
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<tr>
<td>BIOL 407</td>
<td>Herpetology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 409</td>
<td>Mammalogy</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 414</td>
<td>Biology of Marine Invertebrates</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 415</td>
<td>Ecology</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 428</td>
<td>Genetics and Speciation</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 456</td>
<td>Techniques in Vertebrate Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 466</td>
<td>Multivariate Statistics</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 488</td>
<td>Current Topics in Biology</td>
<td>1-4</td>
</tr>
<tr>
<td>BIOL 495</td>
<td>Undergraduate Research</td>
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<tr>
<td>BIOL 497</td>
<td>Special Projects in Biology</td>
<td>1-4</td>
</tr>
<tr>
<td>ENVS 487</td>
<td>Internship in Environmental Sciences</td>
<td>4,8</td>
</tr>
<tr>
<td>ENVS 488</td>
<td>Topics in Environmental Sciences</td>
<td>1-4</td>
</tr>
<tr>
<td>ENVS 495</td>
<td>Special Projects in Environmental Sciences</td>
<td>1-4</td>
</tr>
<tr>
<td>ENVS 497</td>
<td>Undergraduate Research</td>
<td>1-4</td>
</tr>
<tr>
<td>HGIS 421</td>
<td>Cartography and Map Design</td>
<td>3</td>
</tr>
<tr>
<td>HGIS 423</td>
<td>Practical Issues in GIS</td>
<td>4</td>
</tr>
<tr>
<td>HGIS 424</td>
<td>Desktop GIS Software Applications</td>
<td>4</td>
</tr>
<tr>
<td>HGIS 434</td>
<td>Advanced GIS Software Applications</td>
<td>3</td>
</tr>
<tr>
<td>HGIS 435</td>
<td>Sources, Capture, and Integration of GIS Data</td>
<td>3</td>
</tr>
<tr>
<td>HGIS 436</td>
<td>Spatial Analysis with GIS</td>
<td>4</td>
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<td>HGIS 437</td>
<td>GIS in Public Health</td>
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</tr>
<tr>
<td>HGIS 499</td>
<td>Directed Study/Special Project</td>
<td>1-4</td>
</tr>
</tbody>
</table>

Environmental geology
One year of general chemistry and general physics is required for this concentration.

This track will prepare students to objectively study geologic information and apply it to contemporary environmental problems such as pollution, waste management, resource extraction, natural hazards, and human health. For example, an environmental geologist might evaluate the risk and damage potential from natural hazards such as floods, landslides, volcanoes, or earthquakes. They might be involved in a land-use planning process that assesses the impact a sanitary landfill would have on groundwater. This concentration is also appropriate as background for graduate study in areas such as geology and earth sciences.

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>GEOL 204</td>
<td>Physical Geology</td>
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<tr>
<td>GEOL 316</td>
<td>Mineralogy</td>
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</tr>
<tr>
<td>GEOL 317</td>
<td>Igneous and Metamorphic Petrology</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 416</td>
<td>Sedimentology and Stratigraphy</td>
<td>6</td>
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<tr>
<td>GEOL 424</td>
<td>Structural Geology</td>
<td>4</td>
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<tr>
<td>GEOL 426</td>
<td>Invertebrate Paleontology</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 427</td>
<td>Vertebrate Paleontology</td>
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<tr>
<td>GEOL 431</td>
<td>Geochemistry</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 443</td>
<td>Historical Geology</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 455</td>
<td>Modern Carbonate Depositional Systems</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 456</td>
<td>Field Methods of Geologic Mapping</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 465</td>
<td>Hydrogeology</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 488</td>
<td>Topics in Geology</td>
<td>1-4</td>
</tr>
<tr>
<td>GEOL 495</td>
<td>Special Projects in Geology</td>
<td>1-4</td>
</tr>
</tbody>
</table>
Normal time to complete the program

2 years (7 academic quarters) at LLU based on full-time enrollment; part-time permitted

Courses

ENVS 401. Earth System Science and Global Change. 4 Units.
A systems-level approach to understanding environmental issues. Explores the dynamic biogeophysical processes in the atmosphere, biosphere, geosphere, hydrosphere, and sociosphere. Focuses on acquiring an interdisciplinary understanding of the basic principles and concepts of earth system science and the human dimensions of global environmental change.

ENVS 434. The Environmental Context of Community Health. 3 Units.
Studies the biological, ecological, and human environmental factors of a region; and of community health and how environmental factors affect it. Students engage local communities, learn about local ecology and health issues, and participate in ongoing projects that build on community assets and address the key needs. Includes dialogue with community partners as they consider interventions to improve the health of their communities, along with possible implementation strategies. Initial meeting on Loma Linda University campus, followed by on-site environmental and community health study in a developing country.

ENVS 455. Environmental Law and Regulation. 4 Units.
Introduces local, state, federal, and global laws and policies regarding the use, ownership, protection, and regulation of natural resources. Emphasizes understanding of the decision-making process behind the rights and limits of private, public, and governmental parties when utilizing or protecting natural resources.

ENVS 485. Seminar in Environmental Sciences. 0.5 Units.
Selected topics dealing with recent developments. May be repeated for additional credit.

ENVS 487. Internship in Environmental Sciences. 4,8 Units.
Working under the joint supervision of a faculty member and an off-campus sponsor, student develops an environmental sciences academic component within the internship. Student also participates directly in the maintenance or conservation of the environment. May be repeated for additional credit for up to 8 units. Prerequisite: Internship and registration approval by a faculty member in the Department of Earth and Biological Sciences.