

ENVIRONMENTAL SCIENCES – B.S.

Program director

George D. Jackson

The Department of Earth and Biological Sciences offers a program leading to the Bachelor of Science degree in environmental sciences. This program builds upon a strong interdisciplinary foundation in natural, physical, and earth systems sciences, leading to an understanding of the effects of human activities on environmental sustainability and management. In addition, because understanding the environment has become highly dependent upon 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. 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 may choose an advanced expertise in conservation biology and biodiversity, or environmental geology. This program will encourage students to develop critical-thinking skills, healthy lifestyles, and service-oriented attitudes necessary for finding effective and ethical solutions to environmental problems on both a local and global scale.

Program learning outcomes

By the end of this program, the student should be able to:

1. Integrate each of earth's dynamic and interdependent component systems.
2. Critically evaluate the relation of science and faith within an environmental context.
3. Demonstrate written, technical, oral, and problem-solving skills necessary to collect, analyze, and share environmental data with scientific and public communities.
4. Identify professional and academic opportunities in the environmental science field.
5. Discuss concurrent environmental science research.
6. Examine human and natural causes of earth's environmental problems.
7. Address environmental problems as an environmental scientist.

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 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, GIS, climatology, and diverse health sciences; and public policy, law, or planning careers.

Environmental scientists may also become involved through employment or by volunteering with nonprofit organizations such as Adventist Development and Relief Agency International, as well as 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 educational 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 pre-health 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 coursework 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 toward 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 projects within the context of environmental conservation, health, or sustainability in an effort to find new solutions to environmental problems.

Honors program

Students who earn a G.P.A. of 3.0 or above, sponsored by a faculty member and with an approved research proposal, may apply to be accepted into the environmental sciences honors program. The honors student must register for at least 2 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 their research.

Required units and residence requirement

All unit requirements listed are quarter units. Minimum requirements include one year of full-time residence at Loma Linda University, completing 32 of the final 46 units; or a minimum of 45 total units of coursework for the degree at Loma Linda University. If the student has attended an institution that does not grant bachelor's degrees, a

maximum of 105 quarter units of transfer credit from a two-year junior or community college is allowed.

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

Financial information

Tuition, fees, and other cost-of-attendance items are located on the Find a Program (<https://llu.edu/academics/programs/>) webpage.

Scholarships and discounts

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): a 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 nine percent of tuition).

Guidelines

- All scholarships or other financial awards must not exceed costs for tuition and fees.
- If a student qualifies for more than one scholarship or reduced tuition award, the award with the largest dollar value applies.
- Scholarship or tuition reduction will be applied as a credit to the student's tuition account at the rate of one-third of the total per quarter, and is available to full-time students only.
- Loss of scholarship money may result when a student does not maintain the minimum cumulative G.P.A. required by the particular scholarship.
- The last day of final tests for the first quarter that a student is enrolled at LLU is the deadline for verifying with Student Financial Services that the student qualifies for a scholarship for the academic year.
- The scholarships and reduced tuition awards listed here apply only to students enrolled in undergraduate programs in the Department of Earth and Biological Sciences.

Note: Determination of the amount of scholarships and awards at Loma Linda University is influenced by FAFSA data. State and federal grants, as well as other grants and subsidies, will be applied before Loma Linda

University scholarships and discounts; therefore, some students may be eligible to receive only a portion of their scholarship award.

Admissions

The student in the B.S. degree in environmental sciences (ENVS) Program will generally take the first two years of required corequisite coursework (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 coursework at a nearby community college in order to complete their outstanding corequisite requirements.

In addition to Loma Linda University admissions requirements (<http://lluatalog.llu.edu/about-university/admission-policies-information/#admissionrequirements>), 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

Corequisites must be completed at an accredited college or university. These courses are listed as they relate to general education requirements.

Domain 1: Religion (8 quarter units)

(completed during enrollment at LLU)

Domain 2: Arts and humanities (minimum 16 quarter units)

Units must be selected from at least three of the following content areas: civilization/history, art, literature, language, philosophy, religion, or general humanities electives. A minimum of 3 quarter units in an area is required to meet a "content area."

Domain 3: Scientific inquiry and quantitative reasoning (45 quarter units)

- College algebra (four units)
- Statistics (four units) offered at LLU
- Statistics using R (BIOL 305 Statistics Using the R Software Package offered at LLU)
- General biology with laboratory (12 units)
- General chemistry with laboratory (12 units)
- Another 12 credits of physical or life sciences

Domain 4: Social sciences (minimum 12 quarter units)

- Select from two of the following content areas: anthropology, economics, geography, political sciences, psychology, and sociology.
- 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 5: Written and oral communication (minimum 9 quarter units)

- English composition, complete sequence that meets the baccalaureate degree requirements of a four-year college or university.

- Additional courses may include information systems, critical thinking, and public speaking

Domain 6: Health and wellness (minimum 2 quarter units)

- A didactic course in health or nutrition (e.g., personal health, personal nutrition, population health, global health, and community nutrition) minimum of 2 units
- Physical education. Must include at least two separate physical activity courses totaling a minimum of one quarter units.

Electives

To meet the minimum total of 192 quarter units required for the degree. For more information regarding GE requirements for graduation, see LLU general education requirements (<http://llucatalog.llu.edu/about-university/division-general-studies/>).

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Program requirements

Required core courses

BIOL 449	Biodiversity and Conservation	3
BIOL 415	Ecology	3
BIOL 664	Science Communication Outreach	1
ENVS 434	The Environmental Context of Community Health	3
ENVS 455	Environmental Law and Regulation	4
ENVS 485	Seminar in Environmental Sciences ¹	0.5
ENVS 487	Internship in Environmental Sciences	4
GEOL 204	Physical Geology	4
GEOL 434	Introduction to GIS for the Natural Sciences (2)	2
GEOL 435	GIS Spatial Analysis for the Natural Sciences (3)	3
GEOL 464	Science Communication Outreach ²	1
GEOL 475	Philosophy of Science and Origins	4

Concentration

Select a concentration in Conservation Biology and Biodiversity OR Environmental Geology (see descriptions below) 24

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. 8

Religion

REL_ 4__	Upper-division Religion	6
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 accredited college, to meet the 192-unit total requirement

Total Units 72.5

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 Fulfills service learning requirement.

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.

BIOL 406	Marine Biology	4
BIOL 407	Herpetology	3
BIOL 409	Mammalogy	4
BIOL 414	Biology of Marine Invertebrates	4
BIOL 415	Ecology	3
BIOL 428	Genetics and Speciation	4
BIOL 456	Techniques in Vertebrate Ecology	3
BIOL 466	Multivariate Statistics	3
BIOL 488	Current Topics in Biology	1-4
BIOL 495	Undergraduate Research	1
BIOL 497	Special Projects in Biology	1-4
ENVS 487	Internship in Environmental Sciences	4,8
ENVS 488	Topics in Environmental Sciences	1-4
ENVS 495	Special Projects in Environmental Sciences	1-4
ENVS 497	Undergraduate Research	1-4

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.

GEOL 204	Physical Geology	4
GEOL 316	Mineralogy	4
GEOL 317	Igneous and Metamorphic Petrology	4
GEOL 416	Sedimentology and Stratigraphy	6
GEOL 424	Structural Geology	5
GEOL 426	Invertebrate Paleontology	4
GEOL 427	Vertebrate Paleontology	4
GEOL 443	Historical Geology	4
GEOL 455	Modern Carbonate Depositional Systems	3
GEOL 456	Field Methods of Geologic Mapping	4
GEOL 465	Hydrogeology	4

GEOL 488	Topics in Geology	1-4
GEOL 495	Special Projects in Geology	1-4
GEOL 497	Undergraduate Research	1
ENVS 487	Internship in Environmental Sciences	4,8
ENVS 488	Topics in Environmental Sciences	1-4
ENVS 495	Special Projects in Environmental Sciences	1-4
ENVS 497	Undergraduate Research	1-4
HGIS 424	Desktop GIS Software Applications	4

Normal time to complete the program

Four (4) years – two (2) years (seven [7] academic quarters) at LLU – based on full-time enrollment; part time permitted

Courses

ENVS 310. Energy and the Environment. 3 Units.

Reviews the environmental impact of traditional energy sources. Explores novel and emerging sources of renewable energy, including solar, wind, and hydroelectric systems, as well as energy storage and distribution. Focuses on individual, industrial, and community energy requirements and solutions.

ENVS 314. Air Water and Land Pollution. 3 Units.

Covers air quality, accumulated atmospheric pollutants, as well as major types and sources of air pollutants. Deals with water quality and how pollutants impact organisms in aquatic environments, surveying sources of water pollutants that include heavy metals, chemicals, biologicals, and nutrients. Discusses chemical contaminants and visible wastes in relation to agriculture, mineral and energy extraction, and industrial waste.

ENVS 410. Marine Pollution. 3 Units.

Explores contemporary issues of marine pollution such as non-persistent organic and inorganic pollution, microbial pollution, liquid wastes and the impact of coastal wastewater treatment, plastics, and solid wastes including heavy metals. Ecotoxicology topics discuss distribution of marine pollutants, bioaccumulation, biotransformation, and toxicity testing. Addresses monitoring and abatement of marine pollution utilizing biomarkers and pollution control.

ENVS 434. The Environmental Context of Community Health. 3 Units.

Presents biological, ecological, and human environmental factors found in environmental and community health studies. Includes: asset assessments; identification of key needs; and, dialogue with community partners. Consideration of possible implementation strategies and experience in a developing country. Includes three weeks of 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 464. Science Communication Outreach. 1 Unit.

Guided immersion into science communication outreach. Presentation of principles of communication outreach and small group work. Student teams participate in project that interacts with a specific, identified community. Undergraduate students will work with graduate students in small teams and engage collaborative planning to address a community need, then present, evaluate, and reflect on the experience. Cross-listing: GEOL 464.

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.

ENVS 488. Topics in Environmental Sciences. 1-4 Units.

Reviews current knowledge in specified areas of environmental sciences. Registration indicates specific topic to be studied. May be repeated for additional credit. Offered on demand.

ENVS 495. Special Projects in Environmental Sciences. 1-4 Units.

Special project in the field, laboratory, or library under the direction of a faculty member. May be repeated for additional credit.

ENVS 497. Undergraduate Research. 1-4 Units.

Original investigation and/or literature study pursued under the direction of a faculty member. May be repeated for additional credit.