



Center for International Programs and Sustainability Studies

Course name: Principles of Biology

Course code: BIO 1100

Total Contact Hours: 60

COURSE DESCRIPTION

In the Principles of Biology course, students will embark on a comprehensive exploration of the fundamental concepts that underlie the study of life. Throughout the semester, emphasis will be placed on developing a robust understanding of the core themes of biology, enabling students to identify and analyze real-world examples that exemplify these themes. An integral component of the course involves critical thinking skills, particularly in the evaluation of scientific studies related to vaccines, pseudoscience, and other contemporary issues. Students will learn to discern the soundness of study designs, facilitating a nuanced understanding of the scientific method.

Additionally, the course will delve into the hierarchical organization of life, elucidating the emergence of new properties at each level, from molecular structures to complex ecosystems.

Practical skills will be developed as students learn to draw conclusions from data, construct graphs, and create models based on provided information. The intricate web of life processes, from energy transformation in animals and plants to the flow of information in signaling pathways and DNA-to-protein synthesis, will be explored in detail. The course will culminate in a comprehensive understanding of evolution and adaptation, examining how life on Earth has

evolved and elucidating the ways in which structural and functional adaptations contribute to survival and reproduction at both cellular and organismal levels.

CLOTHING AND FOOTWEAR REQUIREMENTS

It is necessary for foreign students to have clothes both for warm climate and for cold (not extreme), as well as closed shoes (hiking shoes and rubber boots if possible) since many field trips are made to highlands, rainy zones, and sometimes to areas with the possible presence of snakes, insects, and other animals. We've never had an accident under those circumstances, but we want our students to be as comfortable and safe as possible. The appropriate clothing and footwear also facilitate the field work of this course.

AUDIENCE

This course is structured for International Students attending the Study Abroad program at Universidad Veritas. However, courses are not exclusive to foreigners so a few native students could enroll in this course. Any person interested in biology is welcome to take this course.

This is a theoretical-practical course and responds according to the professional profile to the following question:

How can a comprehensive understanding of the core themes, scientific methods, hierarchical organization of life, energy transformation, information flow, and evolutionary processes in biology empower individuals to critically evaluate scientific studies, make informed conclusions from data, and appreciate the intricate balance within living systems?

To answer this question, the following **generative** topics will be studied:

- Fundamental concepts of Biology
- Elements of research design and how they impact scientific findings and conclusions.

- Structure and function of biological macromolecules (carbohydrates, lipids, proteins and nucleic acids)
- Cellular structure
- Cellular function, cellular signaling, and cellular transport
- Metabolic pathways: energy, enzymes, cellular respiration and photosynthesis
- Cell division: mitosis and meiosis
- Traits of inheritance
- DNA structure and replication
- The central dogma: from DNA to proteins
- Anatomy and physiology of reproduction
- Biodiversity, evolution, and speciation

Throughout the course the following **skills** will be promoted:

- Developing the ability to critically evaluate scientific studies, discern the soundness of research designs, and distinguish between credible scientific information and pseudoscience.
- Acquiring proficiency in making conclusions from data, drawing graphs, and constructing models based on biological information.
- Gaining a strong foundation in fundamental biological principles, enabling students to understand and interpret scientific information.
- Understanding the structure and function of biomolecules, as well as the biochemical processes involved in gene expression, cell division and cell signaling.
- Grasping the hierarchical organization of life and understanding the emergence of new properties at each level, from small organic molecules to ecosystems.
- Comparing and contrasting the ways animals and plants obtain and transform matter and energy, fostering a deeper understanding of ecological relationships.
- Exploring the principles of evolution and understanding how adaptations contribute to survival, reproduction, and interactions within and between species.

- Applying knowledge of DNA structure and genetic principles to comprehend inheritance patterns and molecular mechanisms governing gene expression.
- Integrating knowledge from various biological disciplines, including cellular and molecular biology, ecology, and genetics, to form a holistic understanding of life processes.

Among the values and attitudes that will be promoted among the students are the following:

- Excellence in performance evidence.
- Responsibility to achieve goals.
- Tolerance to work in group.
- Respect to nature and their ecosystem (organism, stakeholder, and local community)
- Negotiating and knowing how to inspire trust and empathy

The competencies for the Veritas University are reflexive and integral actions that respond to the professional profile and to the problems of the context, with suitability and ethical commitment, integrating the know-how and the of being, know-how and knowledge to grow in a perspective of improvement.

Below are both the disciplinary and general competencies, linked to their criteria and evidence of performance for this course.

Competencies	Key competencies	Evidence of learning
<p>Disciplinary</p> <p>Students will be able to think critically, analyze data, and apply biological concepts to real-world scenarios, fostering a solid</p>	<p>Developing the ability to formulate research questions, design experiments, and critically evaluate scientific studies to contribute to the</p>	<p>Exploring the scientific method</p>

foundation for further studies in biology or related fields.	advancement of biological knowledge.	
	Competency in critically evaluating the design and methodology of scientific studies, enabling students to distinguish between reliable scientific information and pseudoscience.	Thematic discussion Scientific article analyses
	Competent understanding and interpretation of biological principles, enabling effective communication and engagement with scientific literature and discussions.	Thematic discussion Video field trip report
	Competency in integrating knowledge from various biological disciplines, fostering a holistic understanding of life processes and their interconnectedness.	Laboratory practices Essay
	Competency in comparing and contrasting biological processes and structures, leading to a deeper understanding of the	Thematic discussions

	diversity and adaptations within the living world.	
	Competency in applying evolutionary principles to comprehend the diversity of life, adaptation, and the relationships between organisms in various ecological contexts.	Laboratory Practice Reports Project presentation
Core/Generic		
Integrates concepts, nomenclature and key elements from the course to be used in upcoming professional life.	Learning to learn.	Laboratory Practice Reports Project presentation Scientific article analysis Field trip report Group and individual presentations
Develops the knowledge, skills and attitudes necessary to learn how to communicate orally and in writing in the different areas.	Communicate thoughts of the discipline orally, graphically, and in written form.	Laboratory Practice Reports Project presentation Scientific article analysis Field trip report Group and individual presentations
Integrates the knowledge, skills and attitudes necessary to learn the techniques of teamwork and leadership.	Execute teamwork and leadership.	Laboratory Practice Reports Project presentation Scientific article analysis Field trip report Group and individual presentations
Integrates the knowledge, skills and attitudes necessary to learn	Respect towards others. Handles and resolves	Laboratory Practice Reports Project presentation

interpersonal communication techniques.	conflicts. Negotiates knowing how to inspire trust and empathy. Critical and logical thinking	Scientific article analysis Field trip report Group and individual presentations
---	---	--

COURSE CONTENT

Subject 1. Biochemistry and Cell Biology

- What is biology and the scientific method
- Biological organization
- Biological Macromolecules: proteins, carbohydrates, lipids and nucleic acids
- Cell structure and function: describe the role of cells in organisms, compare and contrast prokaryotic and eukaryotic cells, compare and contrast animal and plant cells.
- Cell membranes and major cell organelles
- Cellular transport: passive transport, primary active transport and secondary active transport.
- Metabolic pathways: energy, enzymes, cellular respiration and photosynthesis

Subject 2. Genetics and Molecular Biology

- Cell division: mitosis and meiosis
- Structure of prokaryotic and eukaryotic genomes
- Traits of inheritance: mendelian genetics, genotypes and phenotypes.
- Traits of inheritance: non-mendelian inheritance patterns.
- DNA structure and replication
- Transcription and translation, from DNA to proteins.

Subject 3. Anatomy and Physiology

- Immunity

- Reproduction
- Hormones in the human reproductive system

Subject 4. Biodiversity

- Concepts of species, populations and communities
- Evolutionary forces: genetic drift, gene flow, mutation and natural selection
- Hardy Weinberg equilibrium
- Speciation and adaptation

METHODOLOGY

The methodology employed in this Principles of Biology course is designed to foster a dynamic and engaging learning experience, steering away from traditional exam-centric evaluation. Instead, students will be assessed through a multifaceted approach, emphasizing the application of knowledge and the development of critical skills. Assignments such as debates will challenge students to articulate and defend their perspectives on biological concepts, promoting effective communication and the ability to engage in scientific discourse. Lab practices will provide hands-on experience, allowing students to apply theoretical knowledge in practical settings, reinforcing their understanding of biological principles.

Field reports will encourage students to explore the real-world application of biology through observations and analyses of natural environments. Oral presentations will enhance communication skills and the ability to convey complex biological concepts to a diverse audience. Additionally, mind maps will be employed as a visual tool to synthesize and organize information, promoting a holistic understanding of interconnected biological concepts. By embracing these diverse assessment methods, the course aims to cultivate a comprehensive skill set that extends beyond simple memorization, nurturing critical thinking, problem-solving, and effective communication – essential competencies for success in the field of biology and beyond. The role of the professor is to mediate, facilitate and guide the teaching and learning, allowing students

to build and self-regulate learning, based on their previously collected information. The student is active, the teaching-learning process is collective and socialized. It also fosters social integration, the development of group work skills, community feeling and respect, without neglecting individualization.

EDUCATIONAL RESOURCES

In order to guarantee a good development of the course, therefore, to guarantee learning, the following resources are available: an updated bibliographic database, multimedia equipment that students can use for their individual presentations, whiteboards and other school equipment for weekly sessions, and readings provided by the educator. All of these complement the suggested projects and provide the students with higher possibilities of knowledge ownership. Most of the lessons will take place in the classroom.

During independent work periods students will be able to attend the institution. A campus library, study rooms, and computer labs are available for the students' independent work time. Free Wi-Fi connection for students, educators, and staff is provided on campus, which gives students the possibility to work not only in the library or computer labs, but also around campus.

LEARNING ASSESMENT

In order to make the course or program better competencies-based evaluation compiles and evaluates evidence by taking into account feedback providing pre-established criteria. The course evaluation must be aligned with the competencies and the teaching methodology. There is a rubric for each evaluation resource, and the detail will be reflected in **CANVAS LMS**. Even though the rubric grants a grade, it is also a quantitative and qualitative description of the students' performance. The rubrics include the core and discipline key competences.

Rubrics	Weight
Roundtable Debate: <ul style="list-style-type: none"> ○ One thematic discussion 	10%
Oral Presentation: <ul style="list-style-type: none"> ○ Group/individual oral presentation 	15%
Oral Presentation: <ul style="list-style-type: none"> ○ Group/individual oral presentation 	15%
Field trip report: <ul style="list-style-type: none"> ○ On the concepts of species, populations and communities 	20%
Lab Reports <ul style="list-style-type: none"> ○ Four laboratory practices 	20%
Interview research: <ul style="list-style-type: none"> ○ Includes scientific article and oral presentation 	20%
TOTAL:	100%

LEARNING STRATEGIES

The following learning strategies will be carried out:

1. **Oral presentation:** By means of digital presentations (power-point) each group of students will explain the content pertaining to a topic assigned in advance by the teacher. The students must present at the end of this presentation the bibliographic sources in APA format, Sixth Edition, with a minimum of 5 references and their respective

connection link. From digital presentations, from previously assigned topics, it is intended that students through teamwork or individually can be able to formulate critical and logical ideas that can then be transmitted orally and encourage the rest of the audience (classmates) to issue different points of view.

For the purposes of this course, two oral presentations with a value of **15%** each

- For the first oral presentation, the students will be assigned a topic related to cell biology or biochemistry. They will research and complement it with other resources such as scientific journals, technical reports, etc. to perform a PowerPoint presentation.
- For the second oral presentation: the students will be assigned a topic related to genetics and molecular biology. They will research about this topic and complement with other resources to perform a PowerPoint presentation.

2. Laboratory practices:

Four laboratory practices are going to complement the theory covered in the course. In these laboratory practices students will: 1) Explore different methods to identify biological macromolecules, 2) Observe and compare the processes of mitosis and meiosis in eukaryotic cells, 3) Simulate population dynamics and explore ecological concepts related to population growth, competition, and predation and, 4) Extract DNA from a biological sample and analyze it using gel electrophoresis.

These lab practices aim to enhance students' understanding of diverse biological concepts and methodologies, while also developing practical skills that are applicable in biological research and related fields.

The laboratory sessions will be assessed with a value of **5%** each

Instructions for the students regarding to the different sections of this report are the following:

- a. **Introduction:** this section provides the reader the general knowledge of the topic related to each laboratory practice, which include a summary of each section written in an understandable and logic way. Use scientific articles from recognized journal as a reference. It must be one page (1.5 spaced).
- b. **Objectives:** lab objectives will be provided by the professor during the lab, include them in your reports. It must be 1 general and 2-3 specific objectives.
- c. **Methodology:** this section describes how the activity in the lab was performed, detailing the materials used in the lab (for example: DNA extraction kit, pipettes, centrifuges, tissues samples, etc.), include the specimens where the tissues samples were extracted (use common and scientific names) presented in the lab.
- d. **Results:** this section includes the observations learned during the lab session
- e. **Discussion and conclusions:** this section is most important for the report. It means to compare and contrast the observations against the information provide in the literature, providing differences and similarities between the observations and the information researched about the results obtained. It is expected to read after class about the techniques and methodologies used in the practice in order to be able to provide logic conclusions about the procedures. The discussion must be written in prose and conclusion as a list. References use a APA style. Make sure to use only reliable scientific sources.

3. Debate:

The students will organize in two groups to investigate all the information related to a debate related to the scientific method and/or the theory of evolution and individually, may issue their own opinion by formally interpreting and evaluating a specific topic. The objective is that the student correlates his research and his own knowledge and can clearly argue a possible application in real life. A group of students will dedicate to promote oral expression and investigation on a topic, to produce ideas and points of view that either agree or disagree in order to generate new learning and discussion in the audience. The members of the group must choose a moderator. The moderator begins the discussion, informs the class about the questions from the topic, introduces the members of the roundtable group to the class, indicates when each member of the will intervene; asks previously planned questions, and takes notes that might work as conclusions. The moderator must be emotionally strong, must be unbiased, and must keep the group united. The moderator usually sits in the middle of the group to keep members focused and monitor how people work towards their goals. The group will investigate the topic and will choose a moderator. The debate should last no longer than 20 to 30 minutes to discuss the topics and 5 minutes to draw conclusions.

4. Field trip report:

The field trip will be assessed by means of a report where students collect data and analyze results in the field. The idea, in this case, is that students can interact and observe species, populations and communities in their natural habitat. Students will prepare experiments beforehand and will collect data during the fieldtrip to perform a small study in which they will have their results presented in a scientific article format.

5. Interview Research:

In this assignment, you will embark on a research project to explore the knowledge of hormones in human reproduction in Costa Rica. The goal of this assignment is to delve into the intricate role of hormones in human reproduction by conducting interviews and synthesizing information from scholarly sources. Students will explore the physiological, cultural, and societal aspects that contribute to our understanding of hormones in the context of human reproduction. The students are expected to conduct a comprehensive literature review on hormones involved in human reproduction, exploring their physiological functions, cultural perspectives, and societal implications. Conduct a minimum of 10 interviews with individuals directly involved in or affected by issues related to hormones in human reproduction. Interviewees may include healthcare professionals, reproductive endocrinologists, couples undergoing fertility treatments, educators, and individuals with diverse cultural backgrounds. Develop a set of questions and obtain consent for the interviews. Record or take notes during the interviews.

For the results section and data analysis students will, analyze the information gathered from interviews and literature to identify common themes, trends, and key insights regarding the role of hormones in human reproduction. Then present their findings in a structured format, including: a summary of key points from the literature review, an overview of interviewees and their perspectives, and synthesis of common themes or contradictions in the data. Students are expected to utilize statistical or qualitative data representation (e.g., charts, graphs, quotes).

Finally, students will interpret the implications of your findings regarding the role of hormones in human reproduction. Consider how physiological, cultural, and societal factors intersect in shaping perspectives on this topic. Based on their research, propose specific recommendations for promoting a better understanding of hormones in human reproduction. Consider both educational initiatives and potential improvements in healthcare practices. Suggest potential avenues for future research on hormones in human reproduction and acknowledge any limitations in your study. Summarize the main findings of your research, emphasizing the significance of understanding the role of hormones in human reproduction for healthcare,

education, and societal well-being. Provide a list of all sources cited in your assignment using a consistent citation style of your choosing.

Along the sessions, several none evaluated learning activities will be performed, such as group discussions, brainstorming, topic summaries, small in class research and result sharing, posters and summary cards creations, expert's on specific topics visits and lectures, and laboratory activities when possible. The students will take advantage of the development of mental maps (systems mapping) through which they will be able to investigate, extract, summarize and expose the most important information. A roundtable will also be conducted related to several questions about a controversial documentary to produce ideas and points of view in order to generate a rich discussion in the class.

ATTENDANCE

Students are only allowed a total of 2 nonconsecutive (back to back) absences. The student will fail the course if he/she has more than two absences. Students will have a 0 on any assignment evaluated in class (presentations, evaluations, field trips, etc.) if he/she is absent unless the student presents an official document no later than one week after the absence. If the student presents an authoritative report to excuse the absence, he/she must submit the missed assignment on that same day. An unjustified absence to a field trip will immediately mean losing all of the points assigned to the field trip. If an official document is presented for the field trip absence students will have to present a research assignment to obtain 50% of the points. The only exception to this rule is when two-course field sessions collide in programming. Students can then opt for doing a research assignment not to lose any points. Three late arrivals to class (15 minutes later) are treated as one absence. If you tend to be late for class, you will lose 25% of your total grade.

CODE OF CONDUCT

Professors have the right to expel a student from the classroom should he / she /they:

- Is disruptive in the classroom.
- Behave in a disrespectful way.
- Is under the influence of alcohol or even smell like alcohol.
- Is under the influence of any illegal drug.
- Shows hygiene problems that may disturb other students.

ELECTRONIC DEVICES

The use of cell phones, smart phones, or other mobile communication devices is disruptive, and is therefore prohibited during class. **Please turn all devices OFF and put them away when class begins.** Devices may be used ONLY when the professor assigns a specific activity and allows the use of devices for internet search or recording. Those who fail to comply with the rule must leave the classroom for the remainder of the class period.

BIBLIOGRAPHY

Abercrombie, D. L., Clarke, S. C., & Shivji, M. S. (2005). Global-scale genetic identification of hammerhead sharks: Application to assessment of the international fin trade and law enforcement. *Conservation Genetics* 6:775-788.

Aguirre, A. A., Ostfeld, R. S., Tabor, G. M., House, C., & Pearl, M. C. (Eds.). (2002). *Conservation medicine: ecological health in practice*. Oxford University Press.

Aguirre, A. A., Ostfeld, R., & Daszak, P. (Eds.). (2012). *New directions in conservation medicine: applied cases of ecological health*. OUP USA.

Compagno LSV. (1984). Sharks of the World. An annotated and illustrated catalogue of shark species known to date. Volume I & II. FAO. Rome

Carrier J, Musick J. Heithaus M (2004) Biology of sharks and their relatives. Second Edition. CRC Press. Boca Raton.

CITES. Convention on International Trade in Endangered Species of Wild Fauna and Flora. 15pp.

Dapp D, Arauz R, Spotila JR, O'Connor MP. (2013). Impact of the Costa Rican longline fishery on its by catch of sharks, stingrays, bony fish and olive ridley turtles (*Lepidochelys olivacea*). Journal of Experimental Marine Biology and Ecology 448: 228–239.

Dudgeon, C. L., Blower, D. C., Broderick, D., Giles, J. L., Holmes, B. J., Kashiwagi, T., Krück, N. C., Morgan, J. A. T., Tillet, B. J., & Ovenden, J. R. (2012). A review of the application of molecular genetics for fisheries management and conservation of shark and rays. Journal of Fish Biology 80:1789-1843.

Ebert DA, Fowler S, Compagno L. (2013). Sharks of the world: A fully illustrated guide. Wild Nature Press. Plymouth.

Frankham, R., Ballou, J. D., Briscoe. (2002). Introduction to Conservation Genetics. Cambridge University. Cambridge.

Hamlett WC. (1999). Sharks, skates, and rays: The biology of elasmobranch fishes. Baltimore, MD: Johns Hopkins

University Press. Baltimore.

Lutz PL, Musick JA. (1996). The biology of Sea Turtles. Volume I. CRC Press. Boca Raton.

Lutz PL, Musick JA, Wyneken J. (2002). The biology of sea turtles. Volume II. CRC Press. Boca Raton.

Musick J, Bonfil R (2004) Elasmobranch Fisheries Management Techniques. APEC Fisheries Working Group.

Myers RA, Worm B. (2005). Extinction, survival, or recovery of large predatory fishes. Philosophical Transactions of the Royal Society B: 360:13–20.

Shivji M, Clarke S, Pank M, Natanson L, Kohler N, Stanhope M. (2002). Genetic Identification of pelagic shark body parts for conservation and trade monitoring. Conservation Biology 16:1036–1047.

Wyneken J, Lohmann KJ, Musick JA. (2013). The biology of sea turtles. Volume II. CRC Press. Boca Raton.

CIPSS PROGRAM POLICIES

The student must comply with the provisions of the Veritas University student regimen regulation. To consult it you should go to the student self-management Portal at the following address: <http://autogestion.veritas.cr/> and download it.

CHRONOGRAM

Week	Assignments	Activities
1	Class	Discuss course syllabus / Program weekly / Field trip program/ Introduction
	Class	Conservation Biology in the Sea
2	Class	Extinctions
	Class	Trawl fishing, aquaculture and fishing subsidies
3	Class	Documentary: "Seaspiracy"/ Preparation for roundtable debate
	Roundtable debate	Roundtable debate.
4	Class	Marine invasive species
	Class	Introduction to IUCN & CITES
5	Class	Climate Change
	Oral Presentation	OP: "IUCN report"
6	Class	Evolution
	Class	Speciation/ Adaptations
7	Oral Presentation	OP: "Marine endangered species"
	Class	Conservation Genetics
8	Class	Lab: "CIS Forensic on illegal trade of shark fins"
	Lab	Lab: "CIS Forensic on illegal trade of shark fins"
9	Lab	Lab: "CIS Forensic on illegal trade of shark fins"
	Video Fieldtrip Report/Lab	Lab: "CIS Forensic on illegal trade of shark fins"
10	Lab	Lab: "CIS Forensic on illegal trade of shark fins"
	Lab	Work on Lab Report
11	Lab report	Lab Report/ Work on Final Research Project
	Class	Conservation Genetics a Case Study
12	Class	Work on Final Research Project

	Research presentation/ infographic/ Literature Review	Final Research Presentation
--	--	------------------------------------