

## SCHOOL OF HEALTH AND SCIENCES

### SYLLABUS

<b>TITLE:</b>	General Biology I
<b>CODE:</b>	BIO 111
<b>PREREQUISITE:</b>	N/A
<b>CO-REQUISITE:</b>	BIO 111L
<b>CREDITS:</b>	4 credits   45 contact hours   30 lab hours   1 term

### DESCRIPTION

This course has an approach that allows the formation and integral development of the student of the Natural Sciences program. The fundamental principles of animal and plant life and their relationship with the environment are studied. Emphasis is placed on the level of molecular and cellular organization and on biochemical processes: respiration, photosynthesis, mitosis, and meiosis. Introduction to classical, molecular genetics and biotechnology. The course includes theory and practice.

### JUSTIFICATION

The fundamental concepts discovered by researchers in the field of Biology and their applications in different areas of knowledge affect all aspects of mankind's contemporary life. Recent advancements in the field of Biology, especially Biotechnology, have been astounding and impactful. Research in this field has culminated in organ grafting, in vitro fertilization, cloning, and the production of a diversity of products for therapeutic use via genetic engineering. To be able to understand and evaluate these findings in an intelligent way, as well as other problems of common interest in today's world such as cancer, metastasis, and the effects of the use and abuse of drugs and alcohol, among others, require knowledge in Biology. It is essential that in the training and integral development of the student, the basic knowledge is acquired that allows him or her to understand the world of living organisms in which he or she develops and relates to.

## COMPETENCES

The course develops the following competences in students:

- **Critical questioning**
- **Research and exploration**

## OBJECTIVES

After completion of the course, students will be able to:

1. Recognize scientific methodology in the study of natural phenomena by scientists, pointing out the relationships between biology and other sciences.
2. Use the microscope and other scientific research equipment.
3. Know the structure of the atom and explain the types of bonding of molecules and chemical reactions.
4. Identify cellular organelles, their functions, and the relationships between them.
5. Discuss the mechanisms of cell division in mitosis and meiosis and interpret the meaning of these processes.
6. Explain the processes of respiration and photosynthesis and recognize their importance in the transformation of energy.
7. Identify the chemical nature of genetic material and explain how its function at the cellular level determines hereditary characteristics at the organismic level.
8. Know the basic principles of biotechnology, its applications, and its impact on nature, including humans.
9. Analyze the ethical implications of biotechnology applications in the agricultural, environmental, and medical fields.
10. Analyze the principles of Mendelian inheritance and their subsequent modifications and apply this knowledge to the analysis of inheritance problems.

## CONTENTS

- I. Introduction
  - A. Living vs. nonliving
  - B. Properties of life
  - C. Science and technology
- II. Chemical basis of life
  - A. Organic and inorganic compounds
  - B. Types of bonds
  - C. Hydrolysis and condensation reactions
  - D. Properties of water
  - E. Concept of pH and buffers
    1. Importance for organisms

- F. Biological molecules
  - 1. Carbohydrates
  - 2. Lipids
  - 3. Proteins
  - 4. Nucleic acids
- III. Cell: Structure and Function
  - A. Prokaryote cell
    - 1. Composition and structure
  - B. Eukaryote cell
    - 1. Composition and structure
  - C. Membrane permeability properties
    - 1. Chemical composition
  - D. Transport through the membrane
    - 1. Diffusion
    - 2. Osmosis
    - 3. Active transport
    - 4. Endocytosis and exocytosis
  - E. Cytoskeleton
  - F. Cell cycle and mitosis
- IV. Cellular Metabolism
  - A. Energy transfer
    - 1. Thermodynamic laws
    - 2. Metabolic processes
      - a. Aerobic breathing
      - b. Anaerobic breathing
    - 3. Photosynthesis
      - a. Light reactions
      - b. Darkness reactions (carbon fixation)
- V. Genetics
  - A. Molecular genetics
    - 1. DNA and RNA structure
    - 2. DNA replication
    - 3. Protein synthesis: transcription and translation
  - B. Biotechnology
    - 1. Classic biotechnology
      - a. Fermentation
      - b. Products (bread, cheese, alcoholic drinks)

- c. Selective breeding
    - d. Production of antibiotics
  - 2. Modern biotechnology
    - a. Recombinant DNA technology
      - 1) Applications
    - b. Clones
    - c. Nuclear transfer
    - d. Genetically modified (transgenic) organism
    - e. Stem cells
- C. Types of biotechnology and their applications
  - 1. Microbial
  - 2. Agricultural
  - 3. Animal
  - 4. Forensic
  - 5. Bioremediation
  - 6. Pisciculture
- D. The Genome project and its importance in the sciences
- E. Ethics and biotechnology
  - 1. Ethical problems associated with biotechnology
  - 2. Ethical considerations in research with humans
  - 3. Ethical controversy with genetic testing, stem cells, and cloning
- VI. Mendelian genetics
  - A. Meiosis
  - B. Mendelian inheritance laws
    - 1. Law of segregation
    - 2. Law of independent assortment
    - 3. Crosses
      - a. Monohybrid
      - b. Recessive
      - c. Dihybrid

## LABORATORY EXPERIENCES

- A. Scientific thinking
- B. Buffers and pH
- C. Organic molecules
- D. Operating the microscope
- E. Process of cell transport
- F. Enzyme activity

- G. Cell cycle and mitosis
- H. Aerobic and anaerobic respiration
- I. Photosynthesis
- J. Meiosis
- K. Construction of a DNA molecule model
- L. DNA extraction
- M. Using yeast for alcohol and lactic fermentation
- N. DNA genetic trace

## **METHODOLOGY**

The following strategies from the active learning methodology are recommended:

- Lectures
- Question method
- Incorporation of web tools
- Audiovisual resources (video, presentations, simulations)
- Research Based Learning – RBL
  - Discussion
  - Field visits
  - Lab exercises
  - Independent use of WEB 2.0 (Blog and Mi Sagrado)
  - Individual or group written reports

## **EVALUATION**

Participation	10%
Partial assignments	40%
Final project or exam	25%
Immersion experience	25%
<b>Total</b>	<b>100%</b>

## **LEARNING ASSESSMENT**

The institutional assessment rubric is applied to the course's core activity.

## BIBLIOGRAPHY

### TEXTBOOK

Solomon, E.P., Martin, C.E., Martin, D.W., Berg, L.R. (2019). *Biology* (11<sup>th</sup> ed.)  
Cengage Learning.

Lab: Biology professors. (1999). *Manual de Laboratorio BIO 111*. Universidad del  
Sagrado Corazón.

### REFERENCES

Chaudhry, R., Khaddour, K. (2020). Biochemistry, DNA Replication. In *StatPearls*.  
StatPearls Publishing.

Lai, W., Pugh, B. F. (2017). Understanding nucleosome dynamics and their links to  
gene expression and DNA replication. *Nature Reviews Molecular Cell Biology*,  
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Li, J., Ahat, E., & Wang, Y. (2019). Golgi Structure and Function in Health, Stress, and  
Diseases. *Results and problems in cell differentiation*, 67, 441–485.  
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Niazian M. (2019). Application of genetics and biotechnology for improving medicinal  
plants. *Planta*, 249(4), 953–973. <https://doi.org/10.1007/s00425-019-03099-1>

Rehman, I., & Botelho, S. (2020). Biochemistry, Secondary Protein Structure. In

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Schwarz, D. S., Blower, M. D. (2016). The endoplasmic reticulum: structure, function, and response to cellular signaling. *Cellular and molecular life science: CMLS*, 73(1), 79–94. <https://doi.org/10.1007/s00018-015-2052-6>

van Niel, G., D'Angelo, G., & Raposo, G. (2018). Shedding light on the cell biology of extracellular vesicles. *Nature Reviews Molecular Cell Biology*, 19(4), 213–228. <https://doi.org/10.1038/nrm.2017.125>

van Oorschot, R., Szkuta, B., Meakin, G. E., Kokshoorn, B., & Goray, M. (2019). DNA transfer in forensic science: A review. *Forensic Science International Genetics*, 38, 140–166. <https://doi.org/10.1016/j.fsigen.2018.10.014>

#### ELECTRONIC LINKS

<http://www.SoundersCollege.com/lifesci/titles.html>

<https://www.hhmi.org/news/ribosome-studies-turn-new-mechanism-protein-synthesis>

<https://archive.bio.org/articles/what-industrial-biotechnology>

<https://www.accessscience.com/content/cellular-respiration/1181>

For more information resources related to the course's topics, access the library's webpage <http://biblioteca.sagrado.edu/>

#### REASONABLE ACCOMMODATION

For detailed information on the process and required documentation you should visit the corresponding office. To ensure equal conditions, in compliance with the ADA Act (1990) and the Rehabilitation Act (1973), as amended, any student in need of reasonable accommodation or special assistance must complete the process established by the Vice Presidency for Academic Affairs.

## **ACADEMIC INTEGRITY**

This policy applies to all students enrolled at Universidad del Sagrado Corazón to take courses with or without academic credit. A lack of academic integrity is any act or omission that does not demonstrate the honesty, transparency, and responsibility that should characterize all academic activity. Any student who fails to comply with the Honesty, Fraud, and Plagiarism Policy is exposed to the following sanctions: receive a grade of zero in the evaluation and / or repetition of the assignment in the seminar, a grade of F (\*) in the seminar, suspension, or expulsion as established in the Academic Integrity Policy effective in November 2022.

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