

## SCHOOL OF HEALTH AND SCIENCES

### SYLLABUS

<b>TITLE:</b>	Genetics
<b>CODE:</b>	BIO 223
<b>PREREQUISITE:</b>	BIO 112
<b>CO-REQUISITE:</b>	BIO 223L
<b>CREDITS:</b>	4 credits   45 contact hours   45 lab hours   1 term

### DESCRIPTION

The course is theoretical and practical in nature, including molecular genetics, genetic regulation in both prokaryotic cells and viruses, as well as eukaryotic cells, mutations, and genetic abnormalities. The fundamentals of molecular biology, that are the basis for the development and applications of biotechnology, are analyzed. The ethical and moral repercussions on genetic manipulations are discussed. The principles of Mendelian inheritance and population genetics are studied. In addition, the different experimental techniques by which these principles have been discovered are analyzed. The course consists of lectures and class discussions integrating laboratory experiences related to the topics covered.

### JUSTIFICATION

Genetics is the science that studies the inheritance rules in cells, individuals, and populations, and the molecular mechanisms by which genes control the development, growth, and appearance of an organism. There is no area of biology that can be fully appreciated or understood without the understanding of genetics, because genes in interaction with the environment control cellular processes and all the characteristics that an organism exhibits, as well as determine the course in which evolution occurs. Genetics is, therefore, a basic science whose concepts provide a frame of reference for the training of professionals in the field of science and serves as the basis for the development of the Biology Program. In this way, the student acquires a broad knowledge of the subject, which is essential for pursuing graduate studies in different areas of the sciences.

## COMPETENCES

The course develops the following competences in students:

- **Communication**
- **Research and exploration**
- **Critical questioning**
- **Ethical sense and social justice**

## OBJECTIVES

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

1. Reflect in order to take positions and make judgements about data, research results, and positions related to genetics.
2. Analyze and interpret inheritance problems using mathematical reasoning.
3. Evaluate genetic problems and suggest possible solutions using methodologies and techniques in the Natural Sciences.
4. Recognize the dynamic nature of technology to access and transform information.
5. Demonstrate communication skills in Spanish by clearly stating genetic concepts through written works and oral presentations.
6. Explain the chemical and physical nature of genetic material and its organization in viruses, prokaryotes, and eukaryotes and the mechanisms that occur during the replication, transcription, and translation of genetic material.
7. Explain how the action, functional interaction, and regulation of genes contribute to determining the hereditary phenotypic characteristics of organisms.
8. Work collaboratively in a group on research on a biotechnology topic.
9. Argue about the influence of Biotechnology on the quality of life of individuals in modern society.
10. Explain the mechanisms of genetic recombination in viruses, prokaryotes, and eukaryotes and consequently the laws or principles involved in the transmission of genetic material from one generation to another.
11. Apply the skills of scientific methodology in the solution of simple genetics problems incorporating information and communication technologies.
12. Explain the genetic mechanisms at work in genetic research and analyze their implications in Biology and other areas such as Agriculture and Medicine.
13. Recognize unsolved problems in genetic research and their implications in Biology and other areas such as Agriculture and Medicine.
14. Analyze the economic, social, political, and ethical aspects involved in genetic and biotechnology research.
15. Analyze reliable scientific articles available in various formats in the field of Genetics.

## CONTENTS

- I. Introduction
- II. Classic Genetics
  - A. Mendelian Inheritance
    - 1. Law of segregation
      - a. Test cross
    - 2. Law of independent assortment
  - B. Chromosomal Theory of Inheritance
  - C. Modifications to Mendelian Inheritance
    - 1. Incomplete dominance
    - 2. Multiple alleles
    - 3. Gene interaction
    - 4. Polygene
    - 5. Lethal genes
    - 6. Penetrance and expressivity
    - 7. Pleiotropy
  - D. Inheritance linked to sex
  - E. Determination of sex
  - F. Genetic linkage in eukaryotes
  - G. Genetic map
    - 1. Problem practice
- III. Cell reproduction and inheritance
  - A. Mitosis and meiosis
  - B. Genetic linkage and mapping in prokaryotes and viruses
  - C. Bacteria
    - 1. Transformation
    - 2. Conjugation
    - 3. Transduction
    - 4. Binary fission
  - D. Virus
- IV. Molecular genetics
  - A. Gene chemistry
  - B. Experimental evidence
  - C. Replica
  - D. Transcription
  - E. Translation
  - F. Mutation
  - G. Gene function and structure
  - H. Recombinant DNA

- 1. Cloning techniques
  - I. Transposomes
- V. Genetic regulation in prokaryotes and viruses
  - A. Lac operon of *E. coli*
  - B. Trp operon of *E. coli*
  - C. Regulation of genetic expression
- VI. Genetic regulation in eukaryotes
  - A. Operons in eukaryotes
  - B. Levels of genetic expression
    - 1. Level of transcription
    - 2. Gene splicing and genetic trace
    - 3. Level of post-transcription
- VII. Abnormalities
  - A. Chromosomal variations
- VIII. Biotechnology
  - A. Basic principles
    - 1. Classic vs. modern Biotechnology
    - 2. Eugenics
    - 3. Transgenic organisms
    - 4. Stem cells
    - 5. Bioremediation
  - B. Ethical principles
- IX. Population genetics
  - A. Genetic structure of a population
  - B. Hardy-Weinberg principle
  - C. Genetic variation
  - D. Forces that produce changes in allele frequency
- X. Developmental genetics
  - A. Gene sequencing in development
  - B. Genetic aspects of development

## LABORATORY EXPERIENCES

- A. Probability
- B. Chi-square test
- C. Mitosis
- D. Meiosis
- E. *Drosophila melanogaster* – life cycle and mutants
- F. Genealogy study, Barr chromatin test
- G. Polytene chromosomes in salivary glands

- H. Human karyotype analysis
- I. Chromatographic separation of visual pigments in *Drosophila*
- J. DNA extraction
- K. *E. coli* transformation

## METHODOLOGY

The following strategies from the active learning methodology are recommended:

- Lectures
- Class discussions
- Group presentations
- Case studies
- Presentation of problems
- Group research
- Lab exercises

## EVALUATION

Participation	5%
Partial assignments	40%
Oral presentations	10%
Immersion experience	25%
Final exam	20%
<b>Total</b>	<b>100%</b>

## LEARNING ASSESSMENT

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

## BIBLIOGRAPHY

### TEXTBOOK

Méndez de Ortiz, E. (1986). *Guía de Estudio de Genética*. Universidad del Sagrado Corazón.

Pierce, B., (2020). *Genetics A Conceptual Approach*. (7<sup>th</sup> ed.) McMillan Learning.

## REFERENCES

- Brooker, R. (2017). *Genetics: Analysis and Principles* (6<sup>th</sup> ed.). McGraw Hill Higher Education.
- Hartl, D., Cochrane, B. (2017). *Genetics Analysis of Genes and Genomes* (9<sup>th</sup> ed.). Jones & Bartlett Learning.
- Hartwell, L., Goldberg, M. (2017). *Genetics: From Genes to Genomes* (6<sup>th</sup> ed.). McGraw Hill Higher Education.
- Lewis, R. (2017). *Human Genetics* (12<sup>th</sup> ed.). McGraw Hill Higher Education.
- Mukherjee, S. (2017). *The Gene an Intimate History*. Scribner.
- Sander, M., Bowman, J., Mirabito, P. (2018). *Study Guide and Solutions Manual for Genetic Analysis: An Integrated Approach* (3<sup>rd</sup> ed.). Pearson.

## ELECTRONIC RESOURCES

- [http://www.actionbioscience.org/genomic/carroll\\_ciaffa.html](http://www.actionbioscience.org/genomic/carroll_ciaffa.html)
- [http://www.actionbioscience.org/biotech/baylis\\_robert.html](http://www.actionbioscience.org/biotech/baylis_robert.html)
- <http://www.actionbioscience.org/evolution/king.html>
- <http://www.actionbioscience.org/newfrontiers/davis.html>
- <http://www.biochain.com>
- <http://cellsalive.com/meiosis.htm>
- <http://www.clcbio.com>
- <http://www.dnaancestryproject.com>
- <http://www.esp.org/foundations/genetics/>

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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