

**INTER AMERICAN UNIVERSITY OF PUERTO RICO
METROPOLITAN CAMPUS
SCHOOL OF SCIENCE AND TECHNOLOGY
NATURAL SCIENCE DEPARTMENT
MASTER'S IN SCIENCE IN MOLECULAR MICROBIOLOGY**

SYLLABUS

I. GENERAL INFORMATION

Course Title	:	Microbial Ecology
Code and number	:	MOMI 5300
Credits	:	2
Academic term	:	
Instructor	:	
Office hours and location	:	
Office telephone	:	
E-mail	:	

II. DESCRIPTION

Analysis of microbial diversity at the genetic, physiological, phylogenetic, and functional levels. Application of the concepts of classical ecology to populations and microbial communities with emphasis on the evolutionary bases of biodiversity.

III. OBJETIVES

It is expected that at the end of the course, the student will be able to:

1. Apply ecological concepts about the interactions between microorganisms and hosts and the role of microorganisms in nutrient cycling, in the evolution of life and in the processes that modify the environment.
2. Contextualize the role of Microbiology in the genomic era and understand the importance of microorganisms in human health, in the balance of ecosystems.
3. Evaluate the most recent scientific literature in the area.
4. To promote environmental protection through the knowledge of the importance of microbial microorganisms in the face of the depredation and plundering of our ecological environment.

IV. OBJETIVES

- A. First Unit: Origin and evolution of life
 1. Prebiotic evolution

2. The first cell
 3. RNA world hypothesis
 4. Last Universal Common Ancestor
 5. Endosymbiotic theory
 6. The domains of life (tree of life)
- B. Second Unit: Species Concepts
1. Typological
 2. Phenetic
 3. Morphological
 4. Phylogenetic
 5. Ecological
 6. Biological
 7. Evolutionary
 8. Phylogenomic
- C. Third Unit: Mechanisms of Speciation
1. Anagenesis
 2. Cladogenesis
 3. Gradual speciation
- D. Fourth Unit: Microbial Diversity: from culture to molecular phylogeny
1. Phylogenetic diversity of bacteria
 - a) Phototrophic, chemolithotrophic and methanotrophic bacteria.
 - (1) Purple anoxygenic bacteria
 - (2) Nitrifying bacteria
 - (3) Sulfur-oxidizing and iron-oxidizing bacteria
 - (4) Hydrogen oxidizing bacteria
 - (5) Methanotrophic and methylotrophic bacteria
 - b) Proteobacteria
 - (1) Alphaproteobacteria
 - (2) Gammaproteobacteria
 - (3) Betaproteobacteria
 - (4) Enteric Bacteria
 - (5) Delta and Epsilonproteobacteria
 - c) Firmicutes, Mollicutes and Actinobacteria
 - d) Cyanobacteria
 - e) Chlamydia
 - f) Planctomycetes
 - g) Verrucomicrobia
 - h) Flavobacteria
 - i) Acidobacteria
 - j) Bacteroides and Flavobacterium
 - k) Cytophaga
 - l) Chlorobi-Green Sulfur Bacteria
 - m) Spirochetes
 - n) Deinococcus-Thermi
 - o) Chloroflexi
 - p) Thermotoga
 - q) Aquifex
 - r) Nitrospira and Deferribacter

2. Phylogenetic Diversity of Archaea
 - a) Euryarchaeota
 - b) Crenarchaeota
 - c) Nanoarchaeota
3. Diversity of eukaryotic microorganisms.
 - a) Protists
 - b) Fungi
 - c) Green and red algae
4. Diversity of Viruses
 - a) dsDNA viruses
 - b) ssDNA viruses
 - c) positive-stranded RNA viruses
 - d) negative-stranded RNA viruses
 - e) dsDNA-RT virus
- E. Fifth Unit: Nutrient Cycling and Bioremediation
 1. The Winogradsky Column
 2. Microbial Metabolism
 3. Carbon cycle - transfer in the trophic chains.
 4. Nitrogen cycle
 5. Oxygen cycle
 6. Sulfur Cycle
 7. Phosphorus Cycle
 8. Bioremediation
 9. Phytoremediation
- F. Sixth Unit: Microbial Symbiosis
 1. Microorganism-plant symbiosis
 - a) The Rhizosphere:
 - (1) effects of the root on the microbial population
 - (2) effects of rhizosphere microbial populations in the rhizosphere on the plant
 - b) The Rhizoplane
 - c) Mycorrhizae:
 - (1) Ectomycorrhizae
 - (2) Endomycorrhiza
 - d) Nitrogen fixation in legume nodules:
 - (1) Azorhizobium
 - (2) Rhizobia : Rhizobium; Bradyrhizobium
 - (3) Nodulation
 - e) Nitrogen fixation in nodules of other plants.
 - f) The phyllosphere
 - g) The Laimosphere
 - h) Lichens
 - i) Agrobacterium and Introduction to Biotechnology
 2. Microorganism-animal symbiosis
 - a) Symbiotic associations of photosynthetic microorganisms with animals
 - b) Corals
 - c) Chemolithotrophic microorganisms and marine invertebrates
 - d) Termites (insect microbiome)

- e) The Hoatzin (herbivorous bird)
- f) Ruminants
- g) Fibrodegrading microorganisms (bacteria and rumen archaea)
- h) Pre-gastric and post-gastric fermentation
- i) The gastrointestinal system of the horse
- j) The gastrointestinal system of coprophagous (Capybara)
- k) Indigenous Flora and microbial diseases
- l)

G. The Human Microbiome Project (Human Microbiome Project)

V. LEARNING ACTIVITIES

1. Illustrated lectures in power point format.
2. Audiovisual presentations of animated videos and virtual methods.
3. Additional readings available online on the Blackboard platform.
4. Invited speakers.

VI. EVALUATION

The evaluation of the course will be based on the execution of 2 mid-term exams and a final exam. The final grade will be calculated based on 100% as follows:

	Score	% Final Score
2 Exams	200	60
1 Final Exam	100	40
Total	300	100

Class Attendance and Exams

Class attendance is mandatory. A student who needs to be absent from a class should contact the professor prior to the class by phone or email. There will be no make-up exams, except for reasons of illness. In such case, make-ups will be offered with a doctor's excuse during the final exam period during the professor's office hours.

VII. SPECIAL NOTES

A. Auxiliary services or special needs

All students who require auxiliary services or special assistance must request these at the beginning of the course or as soon as they know that they need them, through the proper registry, in the Office of Orientation with Sr. José Rodríguez.

B. Honesty, fraud, and plagiarism

Dishonesty, fraud, plagiarism and any other inappropriate behavior in relation to academic work constitutes major infractions sanctioned by the General Student Regulations. The major infractions, as stated in the General Student Regulations, may have as a consequence, suspension from the University for a definite period

greater than one year or the permanent expulsion from the University, among others sanctions.

C. Use of electronic devices

Cellular telephones and any other electronic device that could interrupt the teaching and learning processes or alter the environment leading to academic excellence will be deactivated. Any urgent situation will be dealt with, as appropriate. The handling of electronic devices that allow students to access, store or send data during evaluations or examinations is prohibited.

D. Compliance with the Provisions of Title IX

The Federal Higher Education Act, as amended, prohibits discrimination because of sex in any academic, educational, extracurricular, and athletic activity or in any other program or function, sponsored or controlled by a higher education institution, whether or not it is conducted within or outside the property of the institution, if the institution receives federal funds.

In harmony with the current federal regulation, in our academic unit an Assistant Coordinator of Title IX has been designated to offer assistance and orientation in relation to any alleged incident constituting discrimination because of sex or gender, sexual harassment or sexual aggression. The Assistant Coordinator, Sr. George Rivera, can be reached by phone at 787-250-1912, extension 2262 or 2147, or by e-mail griverar@metro.inter.edu.

The Normative Document titled Norms and Procedures to Deal with Alleged Violations of the Provisions of Title IX is the document that contains the institutional rules to direct any complaint that appears to be this type of allegation. This document is available in the Web site of Inter American University of Puerto Rico (www.inter.edu).

VIII. EDUCATIONAL RESOURCES

Textbook

There will not be an assigned textbook for this course, but a selection of essay readings.

Supplementary readings

DeAngelis, K. M., J. M. Gladden, et al. (2010). "Strategies for Enhancing the Effectiveness of Metagenomic-based Enzyme Discovery in Lignocellulolytic Microbial Communities." Bioenerg. Res. 3: 146-158.

Yoshitomo K., Hosokawa, T. and Fukatsu, T. (2011) Specific Developmental Window for Establishment of an Insect-Microbe Gut Symbiosis, Appl. Environ. Microbiol. vol. 77 no. 12 4075-4081

Dominguez-Bello, M. G., E. K. Costello, et al. (2010). "Delivery mode shapes the acquisition and structure of the initial microbiota across multiple body habitats in newborns." Proc Natl Acad Sci U S A 107(26): 11971-11975.

Garcia-Amado, M. A., F. Godoy-Vitorino, et al. (2011). "Bacterial Diversity in the Cecum of the World's Largest Living Rodent (*Hydrochoerus hydrochaeris*)." Microbial ecology.

Godoy-Vitorino, F., K. C. Goldfarb, et al. (2012). "Comparative analyses of foregut and hindgut bacterial communities in hoatzins and cows." The ISME Journal 6(3): 531-541.

- Godoy-Vitorino, F., R. E. Ley, et al. (2008). "Bacterial community in the crop of the hoatzin, a neotropical folivorous flying bird." Appl Environ Microbiol 74(19): 5905-5912.
- Hugenholtz, P. (2002). "Exploring prokaryotic diversity in the genomic era." Genome Biol 3(2): Reviews0003.
- Jackson, C., P. Churchill, et al. (2001). "Successional Changes in Bacterial Assemblage Structure during Epilithic Biofilm Development." Ecology 82(2): 555-566.
- Ley, R. E., M. Hamady, et al. (2008). "Evolution of mammals and their gut microbes." Science 320(5883): 1647-1651.
- Mackie, R. I. (2002). "Mutualistic Fermentative Digestion in the Gastrointestinal Tract: Diversity and Evolution." Integrative and Comparative Biology 42(319-326).
- Palmer, C., E. M. Bik, et al. (2007). "Development of the Human Infant Intestinal Microbiota." PLoS Biology 5(7): 1556-1573.
- Warnecke, F., P. Luginbuhl, et al. (2007). "Metagenomic and functional analysis of hindgut microbiota of a wood-feeding higher termite." Nature 450(7169): 560-565.
- Woese, C. R., O. Kandler, et al. (1990). "Towards a natural system of organisms: proposal for the domains Archaea, Bacteria, and Eucarya." Proc Natl Acad Sci U S A 87(12): 4576-4579.

IX. BIBLIOGRAPHY

Books

1. Larry L. Barton, Diana E. Northup (2011), *Microbial Ecology*, Wiley-Blackwell. ISBN: 978-0-470-04817-7

Electronic Resources

1. Applied and Environmental Microbiology www.aem.asm.org
2. International Society for Microbial Ecology
<http://www.ismemicrobes.org>

Rev: 2022