



MICROBIOLOGY

MED/07 - 6 CFU - 2° Semester

Teaching Staff

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LEARNING OBJECTIVES

Get to know the bacterial cell structures in depth.

Know the main eukaryotes and metazoans related to infections, to toxins, to poisonings, and to environmental contamination.

To know viral and sub-viral structures and their applications in the field of biomedicine

To know the metabolic pathways and their importance in the production processes of products

To know microbial genetics, cell growth, differentiation and other microbial vital forms.

Know the parasitic host relationships both from the point of view of medical microbiology and from the point of view of environmental microbiology

To know the main microbial species of medical interest and the therapeutic modalities

Learn about microbial cultivation techniques, infection control techniques, and general notions about infectious disease prevention

Know the principles of pharmaceutical production and pharmacopoeia.

Know the principles of quality control in microbiology, the principles of diagnostics in food microbiology and environmental microbiology, with particular attention to the health area

COURSE STRUCTURE

Lectures

DETAILED COURSE CONTENT

1. The prokaryotic cell

- a. The organization of the bacterial cell
- b. The capsule and other external structures
- c. The outer membrane and peptidoglycan
- d. The cytoplasmic membrane
- e. The Pili and other types of bacterial appendices
- f. Flagella and bacterial movement
- g. The cytoplasmic organelles
- h. The membrane transport and secretion systems
- i. Bacterial nucleoid

2. Fungi, Algae, Protozoa and Helminths

- a. Fungi
 - Characteristics of fungi and their metabolism
 - The role of fungi in the environment and industry
- b. Algae
 - Algal Features
 - The main phylum of pharmaceutical interest
- c. Protozoa
 - Characteristics of Protozoa
- d. Helminths
 - Major characteristics of Helminths

3. Viruses and sub-viral structures

- a. The organization of the viral particle
- b. Viral symmetry
- c. Replicative classes
- d. Prions
- e. Viroids and virusoides
- f. The bacteriophage

4. Bacterial metabolism

- a. Bacterial nutrition and nutritional classification of bacteria
- b. The glycolytic pathways
- c. The gluconeogenesis
- d. Sugars alternative to glucose sugars:
 - Utilization of polysaccharides (starch, glycogen, cellulose etc)
- e. Metabolism of nitrogen compounds
- f. The tricarboxylic acid cycle, glyoxylate cycle and other cycles
- g. Bacterial respiration:
 - Oxidative phosphorylation (aerobic and microaerobic respiration)
 - The anaerobic respiration
- h. Chemolithotrophy
- i. The fermentative pathways

- j. Features of autotrophic metabolism
- k. Photosynthesis and its diversity
- l. Peptidoglycan synthesis
- m. Protein synthesis
- n. DNA synthesis

5. **Microbial genetics - Cell growth and differentiation**

- a. The concept of transferring genetic information in prokaryotes
- b. Recombination from prokaryotes to eukaryotes
- c. Plasmids
- d. Conjugation,
- e. Transformation
- f. Transduction
- g. Transposable elements
- h. Mutations
- i. The regulation of gene expression: LAC operon
- j. The translational attenuation: the regulation of the TRP synthesis
- k. The cell cycle
- l. The bacterial division
- m. Alternatives to "binary fission"
- n. Vital not cultivable status
- o. The microbial biofilms
- p. The spore and spore-forming bacteria

6. **Host parasite relationships**

- a. Bacterial infection
- b. Viral infection
- c. Fungal infection and its classification
- d. Parasitic infection
- e. The host response to infection

7. **Diversity and systematics of the microbial world**

- a. Special Bacteriology (main features, diseases, chemotherapy and prevention opportunities)
 - The main features of: *Staphylococcus*, *Streptococcus*, *Enterococcus*, *Neisseria*, *Branhamella*, *Mycobacterium*, *Streptomyces*, *Nocardia*, *Actinomyces*, *Corynebacterium*, *Lactobacillus*, *Bartonella*, *Listeria*, *Gardnerella*, *Bacillus*, *Clostridium*, *Enterobacteriaceae*, *Haemophilus*, *Pasteurella*, *Vibrio*, *Legionella*, *Brucella*, *Bordetella*, *Acinetobacter*, *Pseudomonas*, *Bacteroides*, *Campylobacter*, *Helicobacter*, *Mycoplasma*, *Ureaplasma*, *Chlamydiaceae*, *Rickettsiaceae*, *Spirochetaceae*.
- b. Special virology (main features, diseases, chemotherapy and prevention opportunities)
 - The main features of: *Poxviridae*, *Herpesviridae*, *Adenoviridae*, *Papillomavirus* e *Polyomavirus umani*, *Parvoviridae*, *Paramyxoviridae*, *Orthomyxoviridae*, *Picornaviridae*, *Arenaviridae*, *Bunyaviridae*, *Caliciviridae*, *Coronaviridae*, *Filoviridae*, *Flaviridae*, *Reoviridae*, *retrovirus umani*, *Togaviridae* e *Rubivirus*, *virus delle epatiti (HAV, HBV, HCV, HDV, HEV, HGV)*
- c. Special mycology (main features, diseases, chemotherapy and prevention opportunities)
 - *Yeasts: Candida, Cryptococcus, Malassezia, Pnuemocystis*
 - *Moulds: Dermatophytes, Mucormycota, Acremonium, Fusarium, Penicillium, Paecilomyces, Scopulariopsis, Aspergillus*
 - *Dimorphic fungi: Blastomyces, Paracoccidioides, Histoplasma, Sporothrix, Talaromyces*
 - *Dematiaceae: major features*

- d. Special protozoology (main features, diseases, chemotherapy and prevention opportunities):
 - Apicomplexa: *Toxoplasma*, *Plasmodium*, *Cryptosporidium*
 - Hemoflagellates: *Trypanosoma*, *Leishmania*
 - Others: *Trichomonas*, *Amoeba*, *Giardia*, *Balantidium*
- e. Special helminthology:
 - Trematoda: *Schistosoma*, *Fasciola*
 - Cestoda; *Taenia*
 - Nematoda: *Ascaris*, *Trichinella*, *Ancylostoma*, *Necator*, *Filarie*, *Enterobius*, *Anisakis*

8. Infection control. The microbial cultivation techniques. General notions on the prevention of infectious diseases;

- a. Sterilization and disinfection techniques
 - Sterilization by physical methods
 - Sterilization by chemical methods
- b. Preparation of land in the microbiology laboratory
- c. The cultivation of microorganisms: viruses, prokaryotes and eukaryotes
- d. Procedures for the conservation of microorganisms
- e. Sterilization of work environments
- f. Disinfectants
- g. Biosafety
- h. The main antibiotics: mechanism of action and resistance
- i. The main antifungals: mechanism of action and resistance
- j. The main antivirals: mechanism of action and resistance
- k. The main antiparasitics: mechanism of action and resistance
- l. The vaccines

9. Pharmaceutical production and pharmacopoeia.

- a. Evaluation of the contamination of pharmaceutical products
- b. Evaluation of microbial contamination of non-sterile products
 - Pyrogens and bacterial endotoxins
 - Test for pyrogens
 - Test for bacterial endotoxins (LAL test)
- c. Microbiological assay of antibiotics and other Biological dosage
 - Antibiotics
- d. Microbiological characteristics of pharmaceutical products
 - Pharmaceutical preparations must be sterile
 - Pharmaceutical preparation not necessarily sterile

TEXTBOOK INFORMATION

Carlone, Pompei, Tullio, Microbiologia Farmaceutica III Edizione, Edises

Microbiology - <https://courses.lumenlearning.com/microbiology/>

Further resources:

Topley & Wilsons' su: <https://onlinelibrary.wiley.com/doi/book/10.1002/9780470688> (the link must be used within University of Catania network)
