Teaching guide

IDENTIFICATION DETAILS

Degree:	Biotechnology
Scope	Biology and Genetics
Faculty/School:	Experimental Sciences
Course:	MICROBIOLOGY I
Type:	Basic Training
ECTS credits:	6
Year:	2
Code:	2023
Teaching period:	Third semester
Subject:	Biologics
Module:	Fundamental Sciences
Teaching type:	Classroom-based
Language:	Spanish
Total number of student study hours:	150

SUBJECT DESCRIPTION

The subject Microbiology I focuses on the study of the general characteristics of microorganisms as well as the methods of working in the laboratory that allow their identification and study. It begins with a brief historical journey, analyzing the social changes that caused the main milestones of Microbiology. Next, the methods for isolating and studying microorganisms, their cellular organization, their physiology, the mode of growth and their metabolic characteristics are studied in detail. Finally, microbial taxonomy is addressed, analyzing the general characteristics of the main microbial groups, but placing special emphasis on microorganisms of interest from a biotechnological point of view.

Microbiology is the science that deals with the study of microorganisms, a large group of living beings that have in common only their small size and simple organization. It is a science, which, using the scientific method or

hypothetical deductive method, deals with the description, explanation and prediction of phenomena, processes and objects related to the world of microorganisms. Microbiology became a solidly established discipline during the last decades of the 19th century and from this moment on and during the first half of the 20th century, the main interests of microbiologists were the characterization of infectious agents, the study of immunity and its role in the prevention and cure of diseases, the search for chemotherapeutic agents and the analysis of the chemical activity of microorganisms. Microorganisms have therefore played, and continue to play, an essential role as a model for the study of basic biological processes. Disciplines such as Biochemistry, Molecular Biology, Molecular Genetics or Physiology have been developed and understood to a large extent thanks to studies carried out with microorganisms. For this reason, men of science must understand the fundamentals of Microbiology and be aware of the implications that their research may have on humanity. To this end, it is also essential to have anthropological, ethical and social responsibility knowledge that underpins scientific knowledge and is a faithful defense of the dignity and freedom of the person. Throughout history, Microbiology has made great contributions to science that have provided improvements in people's quality of life. From it, new areas and technologies have been developed for application in such important socio-economic fields as medicine, agriculture, industry, food, bioenergy, ecology, etc. However, industrial development and social changes have brought us to the current situation in which the sustainability of life is threatened. This has motivated the United Nations to set out a series of sustainable development objectives included in the 2030 Agenda, in order to ensure the viability of life on the planet and the well-being of people. In addition, this and other international organizations call on the university institution as one of the engines for the training and awareness of professionals who must contribute to the achievement of these objectives. In this sense, from the subject Microbiology I we are going to work to make students aware of the importance of microorganisms in the natural order and sustainable development.

GOAL

The objective of this course is for students to know the types of microorganisms that exist, their main characteristics, the techniques of working in microbiology and to be aware of the importance of microorganisms in the origin and maintenance of life on Earth, as well as the influence they have on other living beings including man.

The specific aims of the subject are:

Understand the importance of microorganisms in maintaining the existing natural order.

Learn basic working techniques in microbiology

Know the general and specific characteristics of the different microbial groups

Identify the biotechnological potential of microorganisms

Know the methods of controlling microbial growth and their importance

PRIOR KNOWLEDGE

To take the subject Microbiology I, it is advisable to have a good level of knowledge in Cell Biology, Chemistry, Thermodynamics and Biochemistry.

COURSE SYLLABUS

SECTION I. INTRODUCTION.
Topic 1.- Importance and historical development of Microbiology Microbiology as an Experimental Science. Origin of Microbiology and historical development. Impact of Microbiology on society.
SECTION II. OBSERVATION METHODS AND STRUCTURE OF MICROORGANISMS.
Theme 2. Microscopy and cell morphology. Size (eukaryotic, prokaryotic, virus and subviral entities). Notions of optics. The compound microscope. Resolution and contrast power. Brightfield microscopy. Stains. Phase contrast, fluorescence and confocal microscopes. Transmission and scanning electron microscopy.
Theme 3. The eukaryotic cell: eukaryotic microorganisms. Protists and Fungi. Cell wall, specific structures, life cycles and biotechnological and medical importance.
Topic 4. The prokaryotic cell: structure and function. Cell size, shape, and clustering. The cell envelope in Gram positive and Gram negative: plasma membrane, cell wall, capsules and mucous layers. Cytoplasmic structures. Photosynthetic structures. Appendices: flagella, endoflagella, fimbriae and pili. Endospore formation.
SECTION III. NUTRITION AND MICROBIAL METABOLISM.
Topic 5. Microbial nutrition. Obtaining carbon and energy. Carbon and energy sources. Nutritional requirements: nitrogen, phosphorus and sulfur. Growth Factors. Nutritional types. Nutrient uptake. Overview of metabolism and bioenergetics.
Theme 6. Types of microbial metabolism. Ways of obtaining energy by microorganisms. Degradation of glucose to pyruvate. Fermentations. Tricarboxylic acid cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Photosynthesis. Overview of anabolism. Peptidoglucan synthesis.
SECTION IV. MICROBIAL GROWTH AND MICROORGANISM CONTROL
Topic 7. Cell cycle and microbial growth. Cell cycle types in prokaryotes. Mechanism of cell division and cell wall synthesis. Types of growing media. Microbial growth curve. Measurement techniques. Synchronous crops and continuous crops. Environmental effects on microbial growth. Growth in natural environments: biofilms.
Topic 8. Control of microbial populations: disinfection and sterilization. Physical sterilization techniques: heat, radiation, filtration. Survival curves and sterilization parameters. Microbial control by chemical agents: disinfectants and antiseptics.
Topic 9. Antimicrobial agents. Antibiotics: types and mechanisms of action. Antibiotic resistance mechanisms. Antifungals. Antiprotozoals. Antivirals. SECTION V. MICROBIAL BIODIVERSITY
Topic 10. Microbial origin and evolution. Hypothesis about the origin of life. Chemical, prebiotic and biological evolution. Bacterial evolution mechanisms. Diversification.
Topic 11. Systematics, phylogeny and taxonomy. Criteria for the classification of microorganisms. Phylogenetic studies and creation of phylogenetic trees. Phylogeny and taxonomic ranks. Biodiversity of microorganisms.
Topic 12. Microbial biodiversity: biotechnologically relevant microorganisms.
Topic 13. Clinical diagnosis and introduction to medical microbiology. Phenotypic and molecular identification. Antibiogram. Bacteriology. Risk groups. Introduction to epidemiology.
SECTION VI. LABORATORY PRACTICES
Block 1. Preparation of culture media and seeding of microorganisms. Sterilization. Sowing bacteria and yeasts in solid and liquid media.
Block 2. Microbial growth and control. Preparation of a bacterial culture: measurement of cell density using the spectrophotometer and representation of a growth curve. Count of colony-forming units.
Block 3. Use of the microscope and observation of microorganisms (bacteria and fungi). Observation of microbial colonies on plates. Observation under an optical microscope: fresh preparations, single stain, spore stain and Gram stain.

Block 4. Effect of antimicrobial agents. Antibiotic effect on a bacterial culture in an exponential growth phase. Preparation of a qualitative and quantitative antibiogram (CMI calculation).

EDUCATION ACTIVITIES

Participatory exhibition classes. They will be taught by the teachers of the subject with computer support: the schemes designed by the teacher of the different subjects are projected, including figures obtained from books and publications. Student participation will be encouraged through questions/problems posed by the teacher and/or students in the classroom and practice laboratory. In some sessions, the inverted class methodology or 'flipped classroom' will be used, in which the teacher will direct the session based on the materials sent previously and that the students have worked individually or in groups prior to the session.
Teamwork. This activity will consist of the preparation of a work on a microorganism of biotechnological interest. To do this, teachers will divide students into working groups and will propose a list of microorganisms of interest. Each group of students will work with a microorganism and at the end of the semester they will make an exhibition on its fundamental characteristics and the reason for their interest in biotechnology. The teachers of the subject will monitor and tutor the students throughout the semester in order to promote their interest in knowing and teaching them good practices in the search and analysis of scientific information. The documentation they prepare for the exhibition will be shared with the rest of the students in the class and will constitute a study tool for the entire group.
Continuous evaluation tests. Evaluation tests will be carried out throughout the course so that the student can self-evaluate the degree of knowledge of the subject continuously over time. These tests do not release subject matter and will include multiple-choice questions and development questions. In addition to summative tests, diagnostic and formative tests will be performed throughout the course.
Practical classes: experimental work in the laboratory. In laboratory practices, students carry out simple experiments that allow them to become familiar with techniques for manipulating and studying microorganisms.
Tutoring. Through tutoring (individual or group), the teacher, at his own request or the student and at the established time for this purpose, will answer questions or discuss the questions posed by the student, in order to guide him in learning the subject. In addition, face-to-face tutoring will be carried out with the work teams to monitor, tutor and evaluate group work.
Seminars: Horizons of Open Reason Cycle, An Encounter with... Seminars given by researchers from other institutions will be organized to deepen topics of interest and to serve to bring our science into dialogue with other disciplines that study life and man.

DISTRIBUTION OF WORK TIME

TEACHER-LED TRAINING ACTIVITIES	INDIVIDUAL WORK
60 Horas	90 Horas

SKILLS

Basic Skills

Students must have demonstrated knowledge and understanding in an area of study that is founded on general secondary education. Moreover, the area of study is typically at a level that includes certain aspects implying knowledge at the forefront of its field of study, albeit supported by advanced textbooks

Students must be able to apply their knowledge to their work or vocation in a professional manner and possess skills that can typically be demonstrated by coming up with and sustaining arguments and solving problems within their field of study.

Students must have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgments that include reflections on pertinent social, scientific or ethical issues

Students must be able to convey information, ideas, problems and solutions to both an expert and non-expert audience

Students must have developed the learning skills needed to undertake further study with a high degree of independence

To acquire firm theoretical, practical, technological and humanistic training needed to develop professional activity.

To be familiar with the applications of biotechnology in the healthcare, food, agrobiotechnological, environmental and chemical fields.

Capacity for teamwork and group management.

Capacity for problem-solving and decision-making.

To develop an ability to search for, take in, analyze, sum up and relate information.

To develop oral and written communication skills.

To acquire the skills needed for experimental work: design, preparation, the compilation of results and the obtainment of conclusions, understanding the limitations of an experimental approach.

General Skills

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Specific skills

Understand the structure and function of the different compartments and organelles of the cell and the relationships that are established between them.

Describe the great morphological, physiological and metabolic variability of microorganisms and their potential for the biotechnology industry.

Work properly in a laboratory with biological material (bacteria, fungi, viruses, animal and plant cells, plants and animals) including safety, handling and disposal of biological waste.

Organize and plan the work in the laboratory correctly.

Know how to describe, quantify, analyze and critically evaluate the results obtained from experimental work carried out in the laboratory.

Point out the origin of antimicrobial agents, the effect they have on microorganisms and their importance in current medicine.

Ability to communicate the knowledge acquired orally and in writing.

Know how to apply the theoretical knowledge acquired to solving problems and practical cases related to different subjects.

Know how to work as a team in an effective and coordinated way.

Be able to self-evaluate the knowledge acquired.

LEARNING RESULTS

To become aware of the importance of microorganisms in maintaining life as we know it.

Differentiate between the different types of microorganisms that exist based on their morphological, physiological, biochemical and genetic characteristics.

Apply knowledge about microorganisms to new projects that provide innovative products and applications.

Formulate experiments that generate new knowledge for biotechnological application.

Review and critique experimental results.

Relate knowledge from different subjects.

Generate thinking and experimental design skills.

Capacity to search, assimilate and present information about the microbial world.

Know the complexity of the cell and be aware of what life involves.

Identify the capacities of microorganisms susceptible to biotechnological application.

Know the cause of the main infectious diseases and ways to combat them.

LEARNING APPRAISAL SYSTEM

The final grade for this subject will be obtained based on the grades obtained in the evaluation of the following modules and it will be necessary to obtain at least 50% of the total grade to consider the subject approved. The exams will be in person. Plagiarism, as well as the use of illegitimate means in evaluation tests, will be sanctioned in accordance with those established in the Evaluation Regulations and the University's Coexistence Regulations.
ORDINARY EVALUATION SYSTEM (this is the default evaluation system for students in this subject)
1- Theoretical block (70% of the grade of the subject). It is mandatory to pass this block with at least half the grade to apply the rest of the percentages.
1.1. Final theoretical exam. 80% of this block will be worth and you must obtain at least 50% of the grade in the two different parts of the exam (multiple choice questions and short questions to be developed), to apply the rest of the percentages.
1.2. Continuous evaluation exams. Throughout the course, 3 written tests will be taken that do not release subject matter. These will be short tests that will be taken in the classroom in no more than 20 minutes. Of the 3 notes, the 2 highest grades will be chosen to make an average that will calculate 20% of the grade of the theoretical block. In this regard, if a student justifies their absence from an exam, they will be given the opportunity to take one more to reach the two grades with which to make an average. If excused absences affect more than two continuous evaluation tests, the student will have the final exam grade as a grade for the theoretical block. In case of unexcused absences, that day's evaluation test will be rated as 0.
2- Practical block (20% of the grade of the subject). Attendance at laboratory practices is mandatory, where students carry out simple experiments that allow them to become familiar with techniques for manipulating and studying microorganisms. The evaluation of this block will be done as explained below
2.1 Exploitation and interest shown during the internship: it will be evaluated by a rubric that will be made public (15%)
2.2 Delivery of a report and/or written exercises on any of the practices (the teacher will announce which after the internships): it will be evaluated by a specific rubric (25%)
2.3 Final practice exam that will take place on the same day as the final theory exam and will evaluate the understanding of the practices (60%). It is mandatory to pass this exam with at least 50% of the grade to apply the rest of the percentages.
3- Teamwork (10% of the subject). This block will evaluate attendance and participation in face-to-face tutoring that will take place during class hours, individually evaluating the interest, dedication, study and rigor of each of the members of the group. In addition, the material prepared for the presentation of the topic will be evaluated with the characteristics of the microorganism studied and its current or potential use in biotechnology.
* In blocks where the contrary has not been specified, it will not be necessary to obtain a minimum grade.
However, if after applying all the percentages, the final grade of the subject is lower than 5, the continuous evaluation items can be recovered, optionally, by asking some extra questions that assess these competencies in

the extraordinary call.
** The grades obtained in the blocks passed will be saved for the extraordinary call of the same academic year but not for the following.
ALTERNATIVE EVALUATION SYSTEM.
Only in the case of students in the second call and later, and students with an academic exemption, who request it in a reasoned manner by mail from the teachers of the subject (during the first week of class). Students in second or subsequent enrollment must contact the teaching team to request to take advantage of this system. In the alternative evaluation system, the same criteria will be applied as in the ordinary system and will be evaluated as follows:
1- Theoretical block: Final theory exam (70%)
2- Practical Block: Final Internship Exam (20%)
3- Teamwork (10%)

ETHICAL AND RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE

1.- The use of any Artificial Intelligence (AI) system or service shall be determined by the lecturer, and may only be used in the manner and under the conditions indicated by them. In all cases, its use must comply with the following principles:
a) The use of AI systems or services must be accompanied by critical reflection on the part of the student regarding their impact and/or limitations in the development of the assigned task or project.
b) The selection of AI systems or services must be justified, explaining their advantages over other tools or methods of obtaining information. The chosen model and the version of AI used must be described in as much detail as possible.
c) The student must appropriately cite the use of AI systems or services, specifying the parts of the work where they were used and describing the creative process followed. The use of citation formats and usage examples may be consulted on the Library website(https://www.ufv.es/gestion-de-la-informacion_biblioteca/).
d) The results obtained through AI systems or services must always be verified. As the author, the student is responsible for their work and for the legitimacy of the sources used.
2.- In all cases, the use of AI systems or services must always respect the principles of responsible and ethical use upheld by the university, as outlined in the Guide for the Responsible Use of Artificial Intelligence in Studies at UFV. Additionally, the lecturer may request other types of individual commitments from the student when deemed necessary.
3.- Without prejudice to the above, in cases of doubt regarding the ethical and responsible use of any AI system or service, the lecturer may require an oral presentation of any assignment or partial submission. This oral evaluation shall take precedence over any other form of assessment outlined in the Teaching Guide. In this oral defense, the student must demonstrate knowledge of the subject, justify their decisions, and explain the development of their work.

BIBLIOGRAPHY AND OTHER RESOURCES

Basic

PRESCOTT, Lansing M. Prescott's Microbiology/11th ed. New York: McGraw-Hill, 2020.

Slonczewski, Joan. Microbiology: an evolving science/5th ed. New York: W.W. Norton & Company, 2020.

Michael T. Madigan... [et al.]. Brock [Electronic Resource]: Biology of Microorganisms/16th ed. Madrid:Pearson, 2021.

Black, Jacquelyn G. Microbiology: principles and explorations/[S. l.] :John Wiley & Sons, 2008.

Additional

Gerard J. Tortora, Berdell R. Funke, Christine L. Case. Microbiology: an introduction/13th ed. Boston: Pearson, 2019.
(Gerard J. Tortora, Berdell R. Funke, Christine L. Case. Microbiology: an introduction/13th ed. Boston: Pearson, 2019. , ||Harley. Laboratory exercises in microbiology/6th ed. McGraw-Hill, 2004.)

José Berenguer, José L. Sanz. Questions in microbiology/Madrid: Hélice, 2003.
(José Berenguer, José L. Sanz. Questions in microbiology/Madrid: Hélice, 2003. , ||Patrick R. Murray. Basic medical microbiology [Electronic resource]/1st ed. Barcelona: Elsevier, 2018.)