

**Microbial Physiology and Metabolism**

Code: 101019  
ECTS Credits: 6

Degree	Type	Year	Semester
2500502 Microbiology	OB	2	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

### Contact

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### Use of Languages

Principal working language: catalan (cat)  
Some groups entirely in English: No  
Some groups entirely in Catalan: Yes  
Some groups entirely in Spanish: No

### Prerequisites

The student must have successfully completed Microbiology and Biochemistry from the Microbiology degree, or subjects of equivalent content.

### Objectives and Contextualisation

The aim of the course is to provide the student with an overall vision of the operation of the different processes that allow growth of prokaryotic cells as well as their adaptation to a changing environment. In the first part of the course, the main elements of the process of structure building and cell growth are presented hierarchically: biosynthesis, polymerization of macromolecules, formation of structures, transport and secretion processes. Emphasis is made in the quantitative assessment of the impact of these processes on global growth expenditure. The subject describes the different mechanisms of energy generation necessary to cover growth expenses. In this part, students learn how to make predictions about the viability of certain metabolic reactions, as well as the tools to determine the energy performance of different types of metabolism. Finally, the student is introduced to some of the elements needed to carry out microbial physiology studies: work with continuous bioreactors, analysis of metabolic budgets and calculation of metabolic rates from steady state data.

### Competences

- Apply knowledge of theory to practice
- Identify and solve problems.
- Know and interpret microbial diversity, the physiology and metabolism of microorganisms and the genetic bases that govern their vital functions.
- Obtain, select and manage information.
- Use bibliography or internet tools, specific to microbiology or other related disciplines, both in English and in the first language.

### Learning Outcomes

1. Analyse the energy yield of different biological reactions.
2. Apply knowledge of theory to practice

3. Calculate the energy cost of the construction of the different cell components.
4. Describe the diversity of mechanisms by which microorganisms adapt to their environment.
5. Determine metabolic rates in closed and continuous culture, and balances of carbon and reducing power of different metabolic processes.
6. Identify and solve problems.
7. Identify the different mechanisms that provide a basis for microbial bioenergetics.
8. Know the factors that regulate cell and population growth populations in closed and continuous culture.
9. Obtain, select and manage information.
10. Solve problems in relation to the metabolism and physiology of microorganisms.
11. Use bibliography or internet tools, specific to microbiology or other related disciplines, both in English and in the first language.

## Content

- 1.- Composition of the bacterial cell.
- 2.- Diversity and relative abundance of cellular components
- 3.- Cellular Envelopes
- 4.- Structure and formation of the cytoplasm components.
- 5.- Protein secretion i prokaryotes.
- 6.- Energetic cost of cellular construction
- 7.- Bioenergetics and electron transport chains
- 8.- Use of organic substrates
- 9.- Fermentative metabolism

*\*Unless the requirements enforced by the health authorities demand a prioritization or reduction of these contents.*

## Methodology

Teaching is carried out through a combination of theory lectures, problem solving sessions, and seminars.

Theory lectures. The theory classes are designed to allow the student to incorporate the elements required to achieve a structured knowledge of the prokaryotic cell function. The contents are taught in the classroom using teaching resources available to the student through moodle.

Problem-solving sessions. These sessions are strictly dedicated to work out, interactively and in small groups, procedures aimed at determining the coherence of experimental data, making metabolic balances and formulating predictions about the viability of different types of metabolism.

Seminars. In the seminars, students carry out a supervised discussion of selected scientific articles related to the content of the subject. The articles are distributed previously together with a questionnaire related to their content. Questionnaires must be completed and delivered before the start of the seminar.

*\*The proposed teaching methodology may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.*

## Activities

Title	Hours	ECTS	Learning Outcomes
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Type: Directed

Problem-solving sessions	10	0.4
Seminars	5	0.2
Theory lectures	30	1.2

Type: Supervised

Tutorial	5	0.2
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Type: Autonomous

Literature search	20	0.8
Problem solving	25	1
Study	31	1.24
Text readings	20	0.8

## Assessment

Assessment will be carried out through two exams each contributing 45% of the final grade. Each of the exams will cover theory (25% of the global grade) and problem-solving (20% of the global grade) contents. The remaining 10% of the grade will complement the exam scores only if both exams have been successfully passed, and will be based on the level of participation in the problem-solving sessions, requiring the completion of the assigned tasks within the established deadlines. To pass the subject the student must obtain 5 or higher in each exam. In the event of failing to pass any of the exams, a reassessment exam is scheduled at the end of the semester. To participate in the reassessment exam, students must have been previously assessed in a set of activities the weight of which equals a minimum of two thirds of the total grade of the subject or module. Students will obtain the "Not Evaluable" qualification when the evaluation activities carried out have a weight lower than 67% of the final grade. Students that, having passed the exams, want to improve their grades may also take the reassessment exam. In the event of taking the reassessment exam, students implicitly renounce to their previously obtained grades.

*\*Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.*

## Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam 1. Theory (25%) + Seminars (20%)	45%	2	0.08	3, 4, 7, 9, 11
Exam 2. Theory (25%) + Problems (20%)	45%	2	0.08	1, 2, 8, 5, 6, 10
Participation in programmed activities	10%	0	0	1, 3, 8, 4, 5, 7, 10

## Bibliography

Lengeler JW, Drews G, Schlegel HG. 1999. Biology of the prokaryotes. Georg Thieme Verlag

Madigan MT, Martinko JM, Stahl D, Clark DP. 2012. Brock Biology of Microorganisms (13th ed.). Pearson

Moat AG, Foster JW, Spector MP. 2002. Microbial physiology (4th ed). Wiley-Liss

Neidhart FC (1999). *Escherichia coli* and *Salmonella*. Cellular and molecular biology, second edition. ASM Press.

Neidhart, FC, Ingraham, J.L. and Schaechter, M (1990) *Physiology of the bacterial cell*. Sinauer Associates, Inc.

Schaechter M., J.L. Ingraham & F.C. Neidhart. 2006. *Microbe*. ASM Press. Washington D.C.

White D. 2006. *The physiology and biochemistry of prokaryotes* (3<sup>a</sup> ed). Oxford University Press. Oxford.