UAB
Universitat Autònoma de Barcelona

Comparative and Environmental Animal Physiology

Code: 100834
Credits: 10

2026/2027

Degree programme	Type	Course
Environmental Biology	OB	2

Contact lecturer

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Group languages

You can consult this information at the end of the document.

Prerequisites

It is recommended to review topics about animal diversity (zoology) and general concepts such as ecology, evolution and cell biology.

Objectives

In this subject, the introduction to the study of the morphological diversity of the various animal groups, is complemented with the description and analysis of comparative physiology in vertebrates and invertebrates. It is intended that the student be able to place each animal group in an ecophysiological context, evaluating it in relation to different aspects such as: the number of species, habitat, life cycle, adaptation to the environment, position within the ecosystems and finally their importance in relation to their particular interest in applied sciences and economic interest.

Targets:

(1) Acquire the formal knowledge in animal physiology, which include:

- The general concepts of adaptation, acclimatization and evolution,
- The concepts and foundations of physiological analysis (homeostasis of perception, integration and response; feedback, amplification and control mechanisms)

- The general description of the main integrative systems (nervous, immune and endocrine systems) including their interactions

(2) Apply the formal knowledge in animal physiology to ecological and symbiotic relationships among several species:

- The physiology of thermoregulation and osmoregulation.
- Differential adaptations between the aquatic and terrestrial environments (respiration, circulation, osmoregulation).
- The physiology of reproduction.
- The physiology of symbiotic interactions in the digestive system.
- The evolutionary physiology of the immune relationships between host and parasite.

(3) Be able to diagnose the advantages and problems of the physiological adaptations in the environment. That is why the necessary materials and knowledge are provided to evaluate the physiological adaptations of a specific species in an environment with specific biotic and abiotic conditions.

Learning outcomes

- CM21 (Effectively communicate to specialist and non-specialist audiences the physiological mechanisms that enable animal life to adapt to the different environments of the planet.) Effectively communicate to specialist and non-specialist audiences the physiological mechanisms that enable animal life to adapt to the different environments of the planet.
- CM22 (As a team, evaluate ways to solve problems and practical cases in the field of animal physiology, developing interpersonal skills inherent to the professional environment (collaborative work, communication, critical thinking, ethical responsibility).) As a team, evaluate ways to solve problems and practical cases in the field of animal physiology, developing interpersonal skills inherent to the professional environment (collaborative work, communication, critical thinking, ethical responsibility).
- KM27 (Describe the function and regulatory mechanisms of the cardiovascular, respiratory, digestive, excretory, reproductive, nervous and endocrine systems of animals, with special emphasis on humans.) Describe the function and regulatory mechanisms of the cardiovascular, respiratory, digestive, excretory, reproductive, nervous and endocrine systems of animals, with special emphasis on humans.
- KM28 (Describe the functional mechanisms underlying the adaptation of animal organisms to different environments.) Describe the functional mechanisms underlying the adaptation of animal organisms to different environments.
- SM26 (Summarize the physiological foundations of the mechanisms of animal organisms that enable their adaptation to different natural environments.) Summarize the physiological foundations of the mechanisms of animal organisms that enable their adaptation to different natural environments.
- SM27 (Apply knowledge of animal physiology to the design of outreach content.) Apply knowledge of animal physiology to the design of outreach content.

Contents

MASTER CLASS MODULES

MODULE I: Foundations of comparative physiology

- Ecophysiological adaptation: key concepts. Proximate and ultimate explanations, adaptation, adaptation and acclimatization. Feedback, homeostasis, alostasis and allostatic load. Coping strategies: proaction and reaction; conformists, regulators and avoiders; eurioics and estenoics. Reaction norms and phenotypic plasticity. Advantages and problems of physiological models: sex-based differences in physiological studies.
- Regulation of physiological systems: the physiology of processes of perception, integration and response in the nervous system. Evolutionary trends in the emergence and complexity of nervous systems: tropisms, neural networks, bilateral nerve systems, encephalisation. Summary of the vertebrate brain. Characteristics of the synapses, action potential and transmission of the nervous

signal. General characteristics of sensory systems, synaptic plasticity and multisensory integration, cortical representation and interpretation. The axes of emotions, stress and reticular activation. Memory formation: synaptic plasticity and long-term potentiation.
- Case study. Evolutionary ecophysiology of echolocation.

MODULE II: the imprint of the environment

Thermal regulation

- Physiological regulation of body temperature in the human species. Mechanisms of heat exchange. Central and peripheral receptors, feedback. Factors influencing the control of basal metabolic rate. Fever and sweat. Homeotherms and poikilotherms. Endotherms and ectotherms. Taquimetabolic and bradimetabolic organisms. Temporary and regional heterotherms. Thermal inertia and body size. Thermal ecophysiology in the deserts: thermal regulation and water balance. Thermal ecophysiology in polar environments: hibernation and freezing.
- Case study (I). Aestivation and the ontogenic plasticity in desert toads.
- Case study (II). Evolutionary ecophysiology of polar fish.

Respiration-circulation coupling

- General characteristics and regulation of the cardiovascular and respiratory physiology. Gas exchange. Factors influencing the changes in hemoglobin. Respiration and acid-base balance. Respiratory height adaptations. Respiratory transitions: from aquatic to terrestrial environment. The diversity of respiratory pigments. Gastrovascular circulatory systems, open and closed. Ecophysiology of external (skin and gills) and internal (air sacs and lungs) respiratory surfaces: (i) countercurrent flow in fish; (ii) skin respiration in the amphibians, (iii) respiratory adaptations in the reptiles, (iv) respiration in estuarine invertebrates, (v) efficiency and physiological regulation of the tracheal system of insects.
- Case study (I). Respiratory ecophysiology of respiration in lungfish.
- Case study (II). Evolutionary ecophysiology of respiration in birds.

The management of water and waste

- Osmoregulation and metabolism of nitrogen in terrestrial animals. Physiological anatomy of the renal function. Mechanisms and regulation of urine concentration. Homeostasis of plasma concentration, blood volume, sodium levels and acid-base balance. Strategies of nitrogenous waste management: ammonotelism, ureotelism and uricotelism. Secretors vs. filterers. Physiological anatomy of osmoregulation and excretion in terrestrial insects: uricotelism, regulation of water and osmolites in the Malpighian tubules. The management of large volumes of water in hematophage insects and saponers. Primitive filtration systems in terrestrial invertebrates: flame cells and nephridia. Adaptative specializations of insects in dry environments: cryptonephric systems and hyperconcentrators.
- Osmoregulation and metabolism of nitrogen in aquatic animals. Osmoconformists strategies in marine invertebrates. Adaptive ecophysiology of osmoregulation and management of metabolic waste in fish: iono-osmoconformers and regulators. Physiological gill models, kidney and gut in ionic and water transport in marine and freshwater fish. Saline glands and rectal reabsorption in birds and marine reptiles.
- Case study. Evolutionary ecophysiology of smoltification in migrating salmons.

The trophic conflict

- Digestive processes. Physiological anatomy of the digestive function. The perception of taste. The regulation and control of the digestion, secretion, absorption and motility in the digestive system. Where and how are fats, proteins and carbohydrates digested? The human Intestinal biota: characteristics of the symbiotic intestinal communities, structural, digestive, metabolic and immune functions. The brain-gut axis: Communication and bidirectional homeostasis between the intestine and the brain in situations of stress, pain and altered behaviors.
- Adaptive solutions to the environmental constraints: compartmentalization, functional and morphological specializations of the digestive tract, reservoirs, extracorporeal digestion, agastria. Insect digestion: functional structure of the digestive tube, peritrophic matrix and fat bodies; digestive symbiosis of xylophagous insects and saba suckers. Energy efficiency and physiology of digestion in birds.
- Case study. Digestive evolutionary ecophysiology of large herbivores.

Reproduction

- Physiology of reproduction. Hormonal control and cycles. Factors influencing the reproductive strategies of animals. Sexual selection,biological cycles, photoperiods, semelparity vs. iteroparity, nutritional environment, induced ovulation, social structure, sequential hermaphroditism. Pheromones: reproductive synchrony, influence of the vomeronasal organ in the sexual behavior of vertebrates. Evolutionary ecophysiology of milk production.
- Case study. Ecophysiology of mammalian diapause.

The interaction with pathogens

- Characteristics of innate and adaptive immunity in vertebrates. Mechanisms of cellular and humoral immunity. Inflammation, cell maturation, reactivity and cellular recirculation. Immune synapsis and antigen presentation: PAMPs and PRRs.
- Case study. Evolutionary ecophysiology of hematophagous insects.

LABORATORY PRACTICES

To be able to attend it, it is necessary for the student to justify having passed the biosafety and security tests that you will find in the Virtual Campus, to know and accept the operation rules of the laboratories of the Faculty of Biosciences.

- P1. Comparative hematology of vertebrates.
- P2. Cardiorespiratory adaptations to exercise.
- P3. Assessment of the immersion reflex in humans.
- P4. Assessment of the stress response following water deprivation.
- P5a and b. Elaboration of an experimental design based on behavioral patterns and responses to temperature changes in fish.

SEMINARS

Analysis of the physiology and biology of the conservation of one particular species in relation to its habitual and / or artificial environment in the context of climate change.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Seminars	10	0.4	CM21, CM22, KM27, KM28, SM26, SM27
Work preparation, solving questions	32	1.28	CM21, CM22, KM27, KM28, SM26, SM27
Laboratory	20	0.8	CM22, KM27
Study	120	4.8	CM22, KM27, KM28, SM26
Theory	57	2.28	KM27, KM28, SM26

The methodology used in this subject to achieve the learning process is based on stimulating the students for working on the information that is provided. The function of the Professor is to give them the information or tell them where they can get it and help tutor them, so that the learning process can be carried out effectively. To achieve this goal, the subject is based on the following activities:

- Master classes: With these classes the student acquires the basic scientific and technical knowledge of the subject that must be complemented with the personal study of the topics explained.
- Seminars: The mission of the seminars is to promote the ability to analyze and synthesize, critical reasoning, and problem-solving skills. In the seminars, the scientific and technical knowledge presented in the lectures is worked on to complete their understanding and deepen them by assessing the

eco-physiological adaptations of animals in their usual environments, highlighting the influence and consequences of climate change on their survival.

- Laboratory practices: The objective of the practical classes is to complete and reinforce, through controlled experimentation in the laboratory, the physiological knowledge acquired in the theoretical classes and seminars, following a specific guideline. In practical sessions empirical skills such as the ability for observation will be stimulated and developed by the student, together with the analysis and evaluation of problems in the usual physiological experimentation. To be able to attend the practicals, it is necessary for the student to justify having passed the biosafety andsecurity tests that can be find in the Virtual Campus and also to know and accept the rules of operation of the Faculty of Biosciences laboratories.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Dossier submission	35%	1	0.04	CM21, CM22, KM27, KM28, SM26, SM27
Lab sessions	15%	4	0.16	CM22, KM27
Second exam (individual)	25%	3	0.12	KM27, KM28, SM26
First exam (individual)	25%	3	0.12	KM27, KM28, SM26

The evaluation consists of 3 tests to assess the knowledge obtained by the student in the subject, as well as its capacity for analysis, synthesis and critical reasoning:

(1) Theoretical contents, individual assessment (50% of the final grade): there will be 2 written partial exams, compulsory and eliminatory of matter. The minimum grade to pass each partial exam is 5. Students who do not pass one of the two partial examinations will be able to retrieve them to the final exam To pass the final exam the grade must be equal to or greater than 5.

(2) Seminars (35% of the final grade): group report on the physiological adaptations to the environment in a specific organism in the context of climate change.

(3) Laboratory practices (15% of the final grade): group report. To be able to attend it, it is necessary for the student to justify having passed the biosafety and security tests that can be find in the Virtual Campus and to know and accept the rules of operation of the laboratories of the Faculty of Biosciences.

To pass the course the student must have passed the individual exam and the final global grade be equal to or greater than 5.

To participate in the recuperation, the students must have been previously evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject or module. Therefore, the students will obtain the qualification of "No Valuable"when the assessment activities carried out have a weighting of less than 67% in the final qualification. It will be considered that a student will obtain the qualification of Non-Valuable if the valuation of all assessment activities performed do not allow to achieve the overall rating of 5 in the assumption that the student had obtained the highest note in all of them. If forjustified reasons (paid work, illness, etc.) the students can not attend any of the tests and / or evaluation seminars, they can retrieve the tests by doing them another day (in the case of the individual examination) or a written work of equivalent evaluation based on a subject matter that will be discussed with the teaching staff.

Single evaluation

(1) Theoretical contents, individual assessment (50% of the final grade): there will be 1 written exam on the day of the 2nd partial exam, compulsory and encompassing all the theoretical contents. The minimum grade to pass the exam is 5. Students who do not pass the exam will be able to test their knowledge of the theoretical contents again in the final exam. To pass the final exam the grade must be equal to or greater than 5.

(2) Seminars (35% of the final grade, attendance is optional): group report on the physiological adaptations to the environment in a specific organism in the context of climate change.

(3) Laboratory practices (15% of the final grade, attendance is mandatory): group report. To be able to attend it, it is necessary for the student to justify having passed the biosafety and security tests that can be find in the Virtual Campus and to know and accept the rules of operation of the laboratories of the Faculty of Biosciences.

To pass the course the student must have passed the individual exam and the final global grade be equal to or greater than 5.

To participate in the recuperation, the students must have been previously evaluated in a set of activities whose weight equals to a minimum of two thirds of the total grade of the subject or module. Therefore, the students will obtain the qualification of "No Valuable"when the assessment activities carried out have a weighting of less than 67% in the final qualification. It will be considered that a student will obtain the qualification of Non-Valuable if the valuation of all assessment activities performed do not allow to achieve the overall rating of 5 in the assumption that the student had obtained the highest note in all of them. If for justified reasons (paid work, illness, etc.) the students can not attend any of the tests and / or evaluation practices, they can retrieve the tests by doing them another day (in the case of the individual examination) or a written work of equivalent evaluation based on a subject matter that will be discussed with the teaching staff.

Irregularities in assessment activities

The occurrence of any irregularity in an assessment activity (academic fraud, plagiarism, or improper use of AI, unless such use is expressly authorized in the course guide) that may lead to a significant alteration of the grade will result in that assessment activity being marked with a 0. If the course guide stipulates that obtaining a minimum grade in that assessment activity is an essential requirement to pass the course, or if multiple irregularities occur in the assessment activities of the same course, the final grade for the course will be 0. Furthermore, independently of these academic consequences, disciplinary proceedings may be initiated against any student who incurs any of these irregularities.

Bibliography

Essential references of general, comparative and environmental physiology.

- Fox, S.I. Fisiología humana. Mcgraw-hill interamericana.
- Hill, R.W. i Wyse, G.A. Animal Physiology. Sinauer.
- Moyes, C.D., i Schulte, P.M. Principios de fisiología animal. Pearson.
- Willmer, P., Stone, G, i Johnston, I. Environmental physiology of animals. Blackwell.

Supplementary references

- Carlson, Neil A. Fisiologia de la conducta. Pearson.
- Cooper, E.L. Advances in Comparative Immunology. Springer.
- García Sacristán, A. Fisiología veterinaria. Editorial Tébar.
- Hickman, C.P. et al. Principios integrales de zoologia, McGraw-Hill.
- Kandel, E.R. et al. Principles of neural science. McGraw-Hill.
- Losos, J. The Princeton Guide to Evolution. Princeton University Press.
- Murphy, K. Immunobiología de Janeway. McGraw-Hill.
- Scanes, C. Sturkie's Avian Physiology. Academic Press.

PubMed, browser for papers in physiology and biomedicine: http://www.ncbi.nlm.nih.gov/sites/entrez

Software

No specialized software packages are required.

Use of AI: In this course, the use of Artificial Intelligence (AI) technologies is not permitted at any stage. Any work that includes fragments generated with AI will be considered a breach of academic integrity and may result in a partial or total penalty in the activity's grade, or more serious sanctions in severe cases.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	22	Catalan	first semester	afternoon
(PAUL) Classroom practices	221	Catalan	first semester	afternoon
(PLAB) Practical laboratories	221	Catalan	first semester	morning-mixed
(PLABs) Suport a les pràctiques de laboratori	221	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	222	Catalan	first semester	afternoon
(PLAB) Practical laboratories	222	Catalan	first semester	morning-mixed
(PLABs) Suport a les pràctiques de laboratori	222	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	223	Catalan	first semester	morning-mixed
(PLABs) Suport a les pràctiques de laboratori	223	Catalan	first semester	morning-mixed