General information	
Academic subject	Animal Ecophysiology
Degree course	Master's Degree in Natural and Environmental Sciences
Academic Year	2021/2022
European Credit Transfer and Accumulation System (ECTS)	6,0 CFU
Language	Italian
Academic calendar (starting and ending date)	06/10/2021 – 20/01/2022
Attendance	Strongly recommended

Professor/ Lecturer	
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Department and address	Room n. 11 or Lab. 37, 4th floor of the building of Biological Departments of the Campus
Virtual headquarters	TEAMS virtual platform
Tutoring (time and day)	Tuesday 15:30 - 17:00, 4th floor of the building of the Biological Departments of the University Campus. It is advisable to check teacher's availability by telephone or e-mail.

Syllabus	
Learning Objectives	The student must be able to: 1) understand what are the main environmental factors that affect living organisms; 2) discuss the different types of animal responses to biotic and abiotic stress; 3) discuss in depth how environmental variability affects physiological processes of great importance such as thermoregulation, osmoregulation, respiration and excretion of nitrogen compounds; 4) acquire practical knowledge for the study of the metabolic responses of animals; 5) discuss the different problems for animals living in airborne, aquatic or other environments.
Course prerequisites	None
Contents	**Thermoregulation.** Activity metabolism. Temperature and metabolism: thermal relationships between an animal and its environment. Effects of temperature and thermal adaptation; definitions of homeothermia, pecilothermia, endothermia, ectothermia, eurythermia and stenotermia. Effects of temperature on the structure of proteins and on the activity of enzymes. The proteins induced by thermal shock (Heat Shock Proteins). Effects of temperature on the structure of the lipid bilayer of biological membranes: homeoviscosal adaptation. The desaturations. Body temperature and thermal exchanges with the environment: conduction, convection, evaporation, radiation. Relationship between body temperature, endogenous production of heat and tolerance to temperature variations. Adaptations to extreme conditions in ectotherms. Adaptations to the cold. Freezing tolerance: ice nucleation proteins and cryoprotectants with colligatic or non-colligative mechanisms. Measures to avoid the formation of ice in the body. Endothermy. Components of the basal metabolism. Control of heat exchanges. Counter-current exchangers. Adaptations of the circulatory system of some species of tuna. Adaptations to heat.

	Osmoregulation. The ionic and osmotic balance. Osmolarity, osmolality and van't Hoff coefficient. The osmotic pressure. Percentage volume of the body's water compartments. Exchanges of ions and water between compartments. Definition of isosmotic and isotonic solutions. The natural terrestrial and aquatic environments. Concentrations of sodium, potassium and chloride in aquatic environments, because the sea contains especially sodium chloride. Mandatory exchanges of ions and water across the body surface. Importance for a cell of its surface to volume ratio. The water permeability of the integument. Effect on the water needs of food, metabolism, temperature, physical activity and breathing. Liquid intake and absorption of moisture from the air. Strategies in response to the osmotic challenges of the environment: avoidance, tolerance, osmoconformity and osmoregulation. Osmoregulation mechanisms in fresh water of Osteichthyes, Amphibians, Reptiles, Birds and Mammals. The mechanisms of osmoregulation of marine animals: Missinoids, Chondrichthyes, Osteichthyes, Coelacants, Reptiles, Birds and Mammals. The mechanisms of osmoregulation of air-breathing animals: humidophilic and xerophilic animals, marine mammals. General information on the osmoregulatory organs of invertebrates. The kidney of the Vertebrates. The nephron and significance of the appearance of Henle's loop. The forces that generate glomerular filtration. The reabsorption. The concentration of urine. General information on the accessory organs of osmoregulation (gills, intestines, rectal gland and salt gland). **The exchange of respiratory gases.** Main gas trading strategies. Fick's first law. Mass transportation. Ventilation and the modalities of respiratory exchange that employ it. Structures responsible for respiratory exchanges: gills and lungs. Modes of aquatic respiration in the main Phyla. Air breathing mode in the main Phyla. The ventilatory cycle of the birds. The arterial duct and the oval foramen in humans. Values of partial pressure of oxygen and carbon dioxide in human circulatory districts. Respiratory pigments. Myoglobin and hemoglobin and their saturation curve. Factors that influence the affinity of hemoglobin for oxygen. The Bohr's effect. The Root's effect. Chlorocruorine. Emeritrine. Hemocyanins. Transport of carbon dioxide in the blood. Balance of carbon dioxide in solution; carbonic anhydrase. Hamburgher effect. Adaptations of vertebrates to diving: the case of mammals. Henry's Law. Gas embolism. Mammalian lung respiration control: regulation of the frequency and depth of ventilation. **Excretion of nitrogen compounds.** Kidney and mechanisms of excretory systems. Ammoniotelic, ureotelic and uricotelic animals. General information on the excretion of creatinine, guanine, allantoin and allantoic acid and trimethylamine oxide.
Books and bibliography	**Fisiologia Animale** Authors: A. Poli, E. Fabbri, C. Agnisola, G. Calamita, G. Santovito, T. Verri. (2nd edition), EdiSES
Additional materials	The use of the textbook is strongly recommended given the complexity of the topics covered. The reference text is also the cheapest among those commercially available and can be consulted at university libraries. The images presented in the lecture slides are mostly contained in the recommended text (and therefore subject to copyright). The contents of the lessons, not present in the book, are elaborated by the teacher in an easy-to-use electronic format and are available to all students.

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
150	44	7,5	98,5
ECTS			
6,0	5,5	0,5	

Teaching strategy	Lectures with slide projection and related discussion, including collective (face-to-face teaching) or associated with remote connection on the TEAMS platform (mixed teaching)
Expected learning outcomes	
Knowledge and understanding on:	Acquisition of knowledge and skills on the physiological mechanisms that take place in response to changes in environmental parameters. This knowledge will be relevant to set up future discussions and find possible solutions to environmental problems.
Applying knowledge and understanding on:	The student will have to be able to apply the knowledge of physiological mechanisms in a global vision of ecosystems and in relation to specific environmental problems. The student will be invited in the classroom, face-to-face or virtual, to compare the various interpretative or summary proposals relating to the issues addressed during the lesson.
Soft skills	• *Making informed judgments and choices* The student must be able to acquire and enhance critical tools to independently develop hypotheses to be associated with knowledge already possessed, until the set objective is achieved. • *Communicating knowledge and understanding* The student will have to acquire a correct language in order to expose and elaborate, also in writing, complex problems in a synthetic, linear and precise but, at the same time, argued way. Furthermore, the student must be able to clearly and comprehensively discuss all the problems relating to the adaptive responses of organisms to the various environmental parameters. • *Capacities to continue learning* The student must be able to understand and elaborate the existing relationships, in the various organisms, between morphology and function and their close correlation with environmental parameters. Furthermore, the student will have to deepen and integrate the knowledge already acquired by contextualizing them to environmental issues.

Assessment and feedback	
Methods of assessment	Verification of students' learning will be carried out through an oral and graphic test aimed at detecting the skills acquired by the student.
Evaluation criteria	• *Knowledge and understanding* the student will have to demonstrate to know all the teaching contents and be able to find the possible correlations between the various topics proposed. Knowledge of the concepts as an end in itself will not be deemed sufficient to pass the exam.

	• *Applying knowledge and understanding* The ability to apply the knowledge acquired will be verified by solving problems proposed extemporaneously. • *Autonomy of judgment* The student will have to 1) demonstrate to be able to rework the knowledge acquired from teaching and develop critical analysis and discussion skills on the topics of Ecophysiology; 2) contextualize teaching issues within current environmental issues. • *Communication skills* The student must demonstrate the ability to know how to apply the knowledge acquired in educational fields. Therefore, the expository properties and the use of an appropriate scientific language in expressing the concepts and formulating the related interpretations will be very positively evaluated, specifically adopting the terminology learned during the attendance of the teaching course . • *Capacities to continue learning* ○
Criteria for assessment and attribution of the final mark	The student will have to demonstrate that he has been able to independently acquire further knowledge on the basis of an interdisciplinary preparation. The demonstration of an acquired ability to expand one's knowledge with an autonomous learning path, can have a very positive response through an increase in the final grade up to the maximum.
Additional information	