PhD Programme in **LIFE, ENVIRONMENTAL AND DRUG SCIENCE** Curriculum 1: BIOMEDICAL Curriculum 2: DRUG SCIENCE Curriculum 3: HUMAN AND ANIMAL BIOLOGY, AND ECOLOGY	
DISCIPLINARY SCIENTIFIC AREAS	03 - CHEMICAL SCIENCES; 05 - BIOLOGICAL SCIENCES
COORDINATOR	PROF. CRISTINA FOLLESA
HEAD DEPARTMENT	DEPARTMENT OF LIFE AND ENVIRONMENTAL SCIENCE
DURATION	3 YEARS
EDUCATIONAL OBJECTIVES AND RESEARCH TOPICS	The PhD programme involves 32 professors, 18 from biology area, 14 from the chemistry area, with multidisciplinary expertise: in biochemistry, pharmacology, genetics and microbiology, aimed at studies in biomedical fields; expertise in zoology, biological anthropology and ecology aimed at environmental biology studies (marine, animal and human); expertise in organic chemistry, pharmaceuticals and pharmaceutical technologies aimed at pharmaceutical development studies. Therefore, the PhD course is organized into three curricula: • Biomedical, in which students focus on research activities in the fields of biochemistry, genetics and microbiology; • Drug Sciences, in which students focus on research activities in the fields of medicinal chemistry, pharmacology, organic chemistry and pharmaceutical technology. • Human and Animal Biology and Ecology, in which students focus on research activities in the fields of anthropology, ecology and zoology; Furthermore, the PhD course activated international agreements with an Asian University (Taipei Medical University) and a European University (University of Porto), which will allow doctoral students to acquire eventually a double international degree. The educational objectives of the PhD programme are divided into three years. With respect to the *first year of the program*, students of all the three curricula will have to: - possess a systematic understanding of a research theme in one of the above described investigational areas; - master the analysis of biological and environmental phenomena and pharmaceutical problems by scientific methodologies and advances and statistic technologies currently used in the above described investigational areas; - deal with problems in the above-described investigational areas by learning to ask questions scientifically relevant; - demonstrate the ability to conceive, design, implement and perform experimental approaches to answer the identified questions. *2nd year of the program*: - knowing how to analyse the results of the research and design further studies that allow for advance in scientific knowledge; - acquire problem solving skills; - deepen the issues of national/international study planning, intellectual property and the exploitation of results; - spend a period of study and research abroad. *3rd year of the program*:

	- complete a period of study and research abroad; - acquire the ability to prepare conference presentations and to write scientific papers in English; - know how to critically evaluate the research developed and propose studies aimed at deepening the thesis. At the end of the PhD, students must: - know how to carry out independent research in the fields of biochemistry, molecular biology, genetics, microbiology, virology, ecology, anthropology, zoology, human and animal biology, pharmacology, pharmaceutical chemistry and pharmaceutical technologies; - have a systematic knowledge of a topic of study in the above fields of investigation; - know how to analyse biological and environmental phenomena and pharmaceutical problems with rigorous methodologies and with the advanced technologies currently used in these fields of investigation; - to be able to tackle problems in these fields and to ask questions of scientific importance; - know how to conceive, design and pursue experimental approaches to adequately address the identified questions; - to make an original scientific contribution to a research theme identified within the aforementioned fields of investigation, showing that it has acquired critical analytical capacity; evaluation and synthesis of new ideas adapted to the complexity of the biological and pharmaceutical systems studied; - to be able to communicate the results of surveys carried out in Italian and English, in written and oral form, to their colleagues, to the national and international academic community; - have mastered English; - have acquired fundamental principles of ethics, gender equality and integrity; - know how to interact in academic, technological and professional, national and international contexts. *Biomedical curriculum* The Curriculum provides a solid knowledge on complex biological systems focused on structural and functional biochemistry of proteins and nucleic acids, integrating notions focused on protein/ligand interactions (i.e. salivary proteins, or interaction viral proteins/small molecules), protein/protein interactions (i.e. viral vs cellular proteins interactions), proteins/nucleic acid interactions (i.e. for proteins involved in autoimmune diseases, RNA for proteins involved in innate immune system down-regulation). More specifically, the investigational areas for this curriculum are: • study of the proteome of biological fluids, human cells or tissues, using top-down and bottom-up proteomic approaches in order to obtain protein profiles useful for the identification of possible biomarkers for the diagnosis of different pathologies; • characterization of the acid-insoluble fraction of the proteome of biological fluids, cells, and tissues by two-dimensional electrophoresis to highlight protein biomarkers of specific diseases; • study of single nucleotide polymorphisms (SNPs) in genes coding for proteins present in biological fluids;

	• analysis of human genomic sequences of retroviral origin involved with autoimmune diseases widespread in Sardinia; • identification and functional characterization of regulatory proteins involved in the pathogenesis of autoimmune diseases; • identification and characterization of new viral targets for therapeutic purposes using biological and computational techniques and identification of new antiviral drugs; • evaluation of the inhibitory activity of newly synthesized compounds against tyrosinase and search for bioactive substances in plant extracts. *Drug Sciences Curriculum* The Curriculum aims at providing a sound knowledge to train qualified experts in the pharmaceutical field. In particular, related issues will be addressed concerning: the synthesis of drugs and bioactive molecules; extraction of biologically active molecules from natural matrices and their qualitative-quantitative characterization by means of analytical techniques; the study of the structure-activity relationships, mechanism of action and the molecular basis of the behavioral effects of newly synthesized and/or naturally derived substances; the application of analytical methodologies for the recognition and dosage of drugs and toxicants; the nutraceutical studies of compounds, the formulation and development of traditional and innovative drug delivery systems, studies of characterization, stability and quality control of the final medicinal products. More specifically, the learning objectives include: • rational design of bioactive molecules also applying computational methods. synthesis through advanced methods, analysis of molecules of biological interest and phytochemical applications; • synthesis and study of organic materials and biological compounds and characterization by spectroscopic techniques. • studies on the nutritional properties and chemical composition of food products and supplements; toxicological risk assessment. • in vivo, ex vivo and in vitro analysis of the molecular basis of the behavioral effects of newly synthesized, naturally derived and/or psychotropic substances • preformulation, design, development, and control of the stability of conventional or innovative drug delivery systems; pharmacokinetics and metabolism studies. *Human and Animal Biology and Ecology Curriculum* The Curriculum provides a solid knowledge regarding the valorisation of marine biodiversity concerning fish and macro-invertebrate species that characterize the sea and inland waters of Sardinia, through theoretical and experimental studies that enhance the quality and safety of food products, with particular attention to the promotion and protection of typical products of the island (eg. bottarga, lobster, sea urchin pulp, shrimp, tuna, octopus). More specifically, the learning objectives for the first year include: The study of the natural environment in all its biotic and abiotic components for the analysis of processes, systems and productive problems with special attention to the marine and brackish ecosystems

	(sea and lagoons).
	The study of conservation and sustainable use of marine biodiversity in the Mediterranean. In particular, the following main topics will be addressed: reproductive cycles, estimates of abundance, distribution, recruitment mechanisms and bio-ecological correlations for Mediterranean teleosts, crustaceans, cephalopods and selachian species.
	The curriculum itself provides skills related to the ability to:
	i) plan interventions for the prevention, management, protection, and conservation of natural resources;
	ii) assess the impact of anthropization,
	iii) design programs of environmental restoration.
	In addition, the Curriculum provides a solid knowledge concerning the definition of micro-evolutionary processes of human populations, in the light of molecular, anthropometric, biodemographic, and osteological data, and those arising from the 'man-environment' interactions.
	More specifically, the learning objectives include:
	- the systematics analysis of fossil remains of the human lineage and the bioarchaeological field in its osteological, paleo-demographic and molecular aspects;
	- study of the evolution of cultures and subsistence strategies in their naturalistic aspects;
	- reconstruction of the history of human settlement through the study of bio-anthropological and molecular markers;
	- study of single-parent molecular markers for the identification of marriage and cultural behaviors, of migration patterns;
	- study of the different susceptibility to disease in human populations; evaluation of anthropometric characteristics and body composition about the life cycle and motor activities.
	
	The PhD students, at the end of the program, will obtain high competencies in one of the above-described investigational areas, a complete judgment autonomy, an adequate communication skill, a high ability to learn new information and apply new technologies to one of the listed research areas.
	Therefore, they will be able to:
	- perform research activities in academia and research centers;
	- perform research and development activities in biomedical, environmental and pharmaceutical companies;
	- perform promotion and developmental activities regarding innovative technologies, new technology design and management in biomedical, environmental and pharmaceutical fields;
	- perform professional activities related to:
	  - the study and understanding of biological phenomena at molecular, genetic and microbiologic level;
	  - the regulated and incremental use of biotic resources in the environmental field;
	  - the design and development of new molecules and release systems in the pharmaceutical field;
	- carry out consultancy activities in the biomedical, environmental and pharmaceutical fields,
	- perform advice activities in biomedical, environmental and pharmaceutical fields.

ELIGIBILITY AND OTHER REQUIREMENTS FOR CANDIDATES (ART. 2 - NOTICE OF COMPETITION)	EVERY ITALIAN 2ND CYCLE DEGREE (LAUREA MAGISTRALE/SPECIALISTICA/VECCHIO ORDINAMENTO) AND EQUIVALENT AND SUITABLE FOREIGN ACADEMIC DEGREES
ADMISSION TESTS	ASSESSMENT OF QUALIFICATIONS AND CURRICULUM VITAE, AND VIDEO CONFERENCE INTERVIEW During the interview, the candidate will discuss his/her 3-year research project. The project (in Italian or English) must be uploaded along with the documents listed in art. 3 of the PhD notice of competition (*Annex A "Titoli valutabili e Curriculum Vitae'; Annex B 'Dichiarazione sostitutiva di certificazioni del/i titolo/i di accesso con esami e voti'; two-sided coloured scanned copy of a valid ID, with a clear photo*), within the deadline (file name: Research project_surname_name - formatting requirements: min. 8,000 max 16,000 characters including spaces - excluding title, schemes, charts and bibliographic references). The project will be evaluated during the interview exclusively and must include: i) purpose of the proposed research project and the related curriculum; ii) state of the art of research; iii) detailed workplan; iv) expected results; v) personal statement, i.e. max. 1500 characters (including spaces) explaining the reasons prompting the candidate to apply for the PhD Programme. More specifically, the candidate will focus on a topic he/she studied in depth, summarizing its fundamental concepts and results, but also explaining the most advanced and innovative aspects. The candidate will also have the opportunity of supposing the future perspectives of the project, considering its theorical and/or operational developments. During the interview, the candidate's language skills in English will be assessed.
ADMISSION TESTS FOR FOREIGN CANDIDATES APPLYING FOR RESERVED POSITIONS SUPPORTED BY A SCHOLARSHIP	ASSESSMENT OF QUALIFICATIONS AND CV, VIDEO CONFERENCE INTERVIEW During the interview, the candidate will discuss his/her 3-year research project. The project (written in English) must be uploaded along with the documents listed in art. 3 of the PhD notice of competition (*Annex A "Titoli valutabili e Curriculum Vitae'; Annex B 'Dichiarazione sostitutiva di certificazioni del/i titolo/i di accesso con esami e voti'; two-sided coloured scanned copy of a valid ID, with a clear photo*), within the deadline (file name: Research_Project_Surname_Name - formatting requirements: min. 8,000 max 16,000 characters including spaces - excluding title, schemes, charts and bibliographic references). The project will be evaluated during the interview exclusively and must include: i) purpose of the proposed research project and the related curriculum; ii) state of the art of research; iii) detailed workplan; iv) expected results; v) personal statement, i.e. max. 1500 characters (including spaces) explaining the reasons prompting the candidate to apply for the PhD Programme. More specifically, the candidate will focus on a topic he/she studied in depth, summarizing its fundamental concepts and results, but also explaining the most advanced and innovative aspects. The candidate will

	also have the opportunity of supposing the future perspectives of the project, considering its theorical and/or operational developments. During the interview, the candidate's language skills in English will be assessed. Reference letters (up to 3) must be written in English, using the form available on the webpage https://www.unica.it/unica/it/studenti_s01_ss05.page (How to apply for PhD selection: Guidelines and forms- Annex C), by a university professor or an expert in the research fields of the PhD programme, on letterhead of their institution, dated and signed. Evaluators will send their letters directly to the email address phdcall_referenceletter@unica.it (object: surname and name of the candidate being evaluated and name of the PhD programme for which he/she is applying).
TOPICS OF THE INTERVIEW	Besides the discussion about the project, the candidates have to demonstrate their knowledge of important topics related to the curriculum of interest. *Biomedical curriculum* Structure, function and metabolism of biological macromolecules. Structures and replication strategies of animal viruses and the mechanism of interaction with host cells. *Human and Animal Biology and Ecology curriculum* Study of the animal and human biodiversity (ecological, morphological and evolutionary aspects) with special attention to the methods and applications related to the management and conservation of natural resources, the ecological processes and the 'man-environment' interactions. *Drug Sciences Curriculum* Nanotechnological applications to drug delivery. Ethanol psychopharmacology in light of its metabolism. Genetic manipulations in neuro-psychopharmacology research. Biopharmaceutical properties of medicines. Conventional and modified release dosage forms. Methodologies and issues related to discovery, design and development of drugs. Antimicrobial agents, Anticancer drugs, Antiviral drugs, Drugs acting on the cardiovascular system, drugs affecting the blood, renal system drugs, drugs affecting the immune system active, or acting on autonomic and the central nervous system.
POSITIONS	6
SCHOLARSHIPS	4 funded by MUR PL, 1 of which reserved for foreign candidates with a degree awarded abroad 1 funded by IMC Foundation - International Marine Centre. Research topic: *Identification and evaluation of the trade-offs of ecosystem services provided by the ecosystems of coastal lagoons* (Contact person: Dott.ssa Erika Porporato)
POSITIONS WITHOUT SCHOLARSHIP	1
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