UNIONE EUROPEA
Fondo Sociale Europeo

Ministero dell'Università e della Ricerca

PON RICERCA E INNOVAZIONE

Università degli Studi di Cagliari

**International PhD Programme in**
**LIFE, ENVIRONMENTAL AND DRUG SCIENCE**
**in collaboration with**
**- Taipei Medical University (College of Medicine and College of Pharmacy)**
**- Universidade do Porto**

Curriculum 1: BIOMEDICAL
Curriculum 2: HUMAN AND ANIMAL BIOLOGY, AND ECOLOGY
Curriculum 3: DRUG SCIENCE

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| DISCIPLINARY SCIENTIFIC AREAS | 03 – CHEMICAL SCIENCES; 05 – BIOLOGICAL SCIENCES; |
| COORDINATOR | PROF. SIMONA DISTINTO |
| HEAD DEPARTMENT | DEPARTMENT OF LIFE AND ENVIRONMENTAL SCIENCE |
| DURATION | 3 YEARS |
| LEARNING OUTCOMES AND RESEARCH TOPICS | The PhD programme involves 28 professors, 16 from the biology area and 12 from the chemistry area, with multidisciplinary expertise: in biochemistry, pharmacology, genetics and microbiology, aimed at studies in biomedical fields; expertise in zoology, biological anthropology, ecology aimed at environmental biology studies (marine, animal and human); expertise in organic chemistry, pharmaceuticals and pharmaceutical technologies aimed at pharmaceutical development studies.<br>The PhD course is organized into three curricula:<br>• Biomedical, in which students focus on research activities in the fields of biochemistry, genetics and microbiology;<br>• Human and Animal Biology and Ecology, in which students focus on research activities in the fields of anthropology, ecology and zoology;<br>• Drug Sciences, in which students focus on research activities in the fields of medicinal chemistry, pharmacology, organic chemistry and pharmaceutical technology.<br>Furthermore, the PhD course activated international conventions with an Asian University (Taipei Medical University) and a European University (University of Porto), which will allow doctoral students to eventually acquire a double international degree.<br><br>The educational objectives of the PhD programme are divided in three years.<br>With respect to the *first year of the program*, students of all the three curricula will have to:<br>- possess a systematic understanding of a research theme in one of the above described investigational areas;<br>- 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;<br>- deal with problems in the above described investigational areas |

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 to 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.

*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.

*Human and Animal Biology and Ecology Curriculum*

The Curriculum provides a solid knowledge regarding the valorisation of marine biodiversity with reference to 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 regard 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 anthropisation,
iii) design programs of environment 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 of 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 behaviours and of migration patterns;
- study of the different susceptibility to diseases in human populations; evaluation of anthropometric characteristics and body composition in relation to the life cycle and motor activities.

*Drug Sciences Curriculum*
The Curriculum aims at providing a sound knowledge to train qualified experts in the pharmaceutical field.
In particular, 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 behavioural 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

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| | methods, synthesis through advanced methods, analysis of molecules of biological interest, phytochemical applications;<br>• synthesis and study of organic materials and biological compounds and characterization by spectroscopic techniques.<br>• studies on the nutritional properties and chemical composition of food products and supplements; toxicological risk assessment.<br>• in vivo, ex vivo and in vitro analysis of the molecular basis of the behavioural effects of newly synthesized, naturally derived and/or psychotropic substances<br>• preformulation, design, development, and control of the stability of conventional or innovative drug delivery systems; pharmacokinetics and metabolism studies.<br><br>The PhD students, at the end of the program, will obtain high competences 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.<br>Therefore, they will be able to:<br>- perform research activities in academia and research centers;<br>- perform research and development activities in biomedical, environmental and pharmaceutical companies;<br>- perform promotion and developmental activities regarding innovation technologies, new technology design and management in biomedical, environmental and pharmaceutical fields;<br>- perform professional activities related to:<br>- the study and understanding of biological phenomena at molecular, genetic and microbiologic level;<br>- the regulated and incremental use of biotic resources in the environmental field;<br>- the design and development new molecules and release systems in the pharmaceutical field;<br>- carry out consultancy activities in the biomedical, environmental and pharmaceutical fields,<br>- 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.<br>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 |

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| | include:<br>i) purpose of the proposed research project and the related curriculum;<br>ii) state of the art of research;<br>iii) detailed workplan;<br>iv) expected results;<br>v) motivation letter, i.e. max. 1,000 characters (including spaces) explaining the reasons prompting the candidate to apply for the PhD Programme.<br><br>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.<br>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<br>During the interview, the candidate will discuss his/her 3-year research project. The project (in English) must be uploaded along with the documents listed in art. 3 of the PhD notice of competition (*certificate attesting the award of a 2nd level foreign degree needed to access a PhD programme, including exams and marks, with a translation in Italian or English; certificate attesting the award of a 1st level foreign degree, including and marks, with a translation in Italian or English; signed Curriculum Vitae preferably in EU format, in English or Italian; up to 3 reference letter(s), in English or Italian, on institutional letterhead paper, dated and signed by a university professor or expert in the PhD scientific area(s), following the prescriptions of each annex; additional qualifications, certifications, publications (up to 5) and work experiences, detailed in English or in Italian; 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:<br>i) purpose of the proposed research project and the related curriculum;<br>ii) state of the art of research;<br>iii) detailed workplan;<br>iv) expected results;<br>v) motivation letter, i.e. max. 1,000 characters (including spaces) explaining the reasons prompting the candidate to apply for the PhD Programme.<br><br>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.<br>During the interview, the candidate's language skills in English will be assessed.<br>Reference letters must be written in English, using the form available |

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| | on the webpage https://unica.it/dottoratiricerca (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 the knowledge of important topics related to the curriculum of interest.<br>*Biomedical curriculum*<br>Structure, function and metabolism of biological macromolecules. Structures and replication strategies of animal viruses and the mechanism of interaction with host cells.<br>*Human and Animal Biology and Ecology curriculum*<br>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.<br>*Drug Sciences Curriculum*<br>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 activity, or acting on autonomic and the central nervous system. Nanotechnological applications to drug delivery. Biopharmaceutical properties of medicines. Conventional and modified release dosage forms. Ethanol psychopharmacology in light of its metabolism. Genetic manipulations in neuro-psychopharmacology research. |
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| SCHOLARSHIPS | 2 FUNDED BY MUR "2019-2020 PLANNING EX ART. 1 D.M. N. 435/2020 STATE UNIVERSITIES"<br>2 FUNDED BY MUR PL, 1 OF WHICH RESERVED FOR FOREIGN CANDIDATES HOLDING A FOREIGN DEGREE |
| POSITIONS WITHOUT SCHOLARSHIP | 1 |
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