UNIVERSITY OF NAPLES FEDERICO II
POLYTECHNIC AND BASIC SCIENCES SCHOOL

DEPARTMENT OF BIOLOGY

STUDENT GUIDE

Master's Degree Course in Biology and Ecology of the Marine Environment and Sustainable Use of Marine Resources

Class of the Degrees in Biological Sciences, Class N. LM-6

ACADEMIC YEAR 2020/2021

Naples, July 2020

Mission of the Master Degree and Job Prospects

The Master's Degree in Biology and Ecology of the Marine Environment and Sustainable Use of Marine Resources has been developed by University "Federico II" and the "Anton Dohrn" Zoological Station.

Mission
Its mission is to train highly specialized marine biologists capable of planning and executing marine ecosystem management and conservation strategies.

The Master's Degree harnesses the teaching and professional competencies of the most distinguished Italian and international marine biologists. Moreover it offers students privileged access to an exclusive network of international bodies that include ASSEMBLE, the Association of European Marine Biological Laboratories, and EMBRC, the European Marine Biological Resource Centre.

1st and 2nd year subjects include:

- Monitoring and conservation of animal, plant and microbial biodiversity
- Survival strategies of marine organisms and mechanisms underpinning trophic network structure and dynamics
- Analysis of marine organism eco-physiological and pathological responses
- Evaluation of physicochemical, climatic and geological dynamics of the marine environment
- Biomonitoring methods including field work (e.g. scuba diving and activities aboard the Zoological Station mother ship)
- Biomolecular applications of marine organisms (algae, animals, micro-organisms and viruses) in pharmacology and biomedicine
- Informatics and bioinformatics tools for data management and modelling to assess ecosystem biodiversity and dynamics

Competencies and Skills Acquired by Graduate Students
The curriculum of the Master's Degree has been conceived to provide a broad range of professional skills and competencies. Our graduates will be at home both in basic science labs and in jobs involving scientific and technological research and innovation for the management and sustainable exploitation of marine resources.

Job Prospects include work with

- Public and private research bodies;
- Public and private bodies involved in marine resource protection and management (regional, provincial and municipal bodies, ARPA);
- Public bodies involved in the management and protection of coastal areas and in recovery of polluted sites;
- Environmental services and consulting companies;
- Biomedical and pharmacological industries;
- Popularization.

There is no entry test

Information on how to register can be found on the sites:

www.scuolapsb.unina.it.
www.dipartimentodibiologia.unina.it
http://bit.ly/laurea-mare

Manifesto of Studies

Teaching or training activity	Module	CFU	SSD	Tip. (*)	Disciplinary fields	Prerequisites
I Anno – I semestre						
Chemical and Physical Oceanography		6	GEO/12	4	Earth Science	
Biodiversity and Marine biomonitoring	Plant biodiversity	6	BIO/01 BIO/02 BIO/03	2	Biodiversity and Environment	
	Animal biodiversity and biomonitoring of the marine environment	6	BIO/05	2	Biodiversity and Environment	
Marine Microbial Biodiversity		6	BIO/19	2	Biomolecular	
Compulsory module		6		3		
Scientific English		4		5		
I Anno – II semestre						
Reproductive and Developmental Biology of Marine Vertebrates		6	BIO/06	2	Biodiversity and Environment	
Marine Ecology and Pathology	Marine Ecology	6	BIO/07	2	Biodiversity and Environment	
	Marine Pathology	6	VET/03	4	Veterinary sciences	
Master Thesis preparatory activity		4		3		
Master Thesis activity		10		5		
II Anno						
Physiology of Marine Organisms		6	BIO/09	2	Biomedical	
Biochemical adaptations to the Marine Environment and methods for Bioremediation		6	BIO/10	2	Biomolecular	
Marine Conservation Genetics and Genomics	Conservation Genetics	6	BIO/18	2	Biomolecular	
	Marine Genomics	6	BIO/11	2	Biomolecular	
Compulsory module		6		3		
Master Thesis activity		24		5		

Notes:

a) The student will be able to follow other things, training activities indicated in the following table B

(*)Legend of the types of training activities pursuant to the Ministerial Decree 270/04

Training activity	1	2	3	4	5	6	7
rif. DM270/04	Art. 10 comma 1, a)	Art. 10 comma 1, b)	Art. 10 comma 5, a)	Art. 10 comma 5, b)	Art. 10 comma 5, c)	Art. 10 comma 5, d)	Art. 10 comma 5, e)

Table B
Compulsory modules

Teaching or training activity	Module	CFU	SSD	Tipology (*)	Prerequisites
Algal biology		6	Biodiversity and Environment	3	
Scuba Diving		6	BIO/01-05	3	
Management of marine resources		6	Biodiversity and Environment	3	
Biogeochemical cycles		6	BIO/07	2	
Marine Geology		6	GEO/03	2	

training actvities

Teaching: CHEMICAL AND PHYSICAL OCEANOGRAPHY	
Module: 1	
CFU:6	**SSD: GEO/12**
Teaching Hours: 40	**Hours of laboratory practice: 8**
Course year: first	
Goals: knowledge of physical, chemical and geological mechanisms underlie the functioning of the marine system, needed for the understanding of the interactions with the biotic component	
Contents: Physical properties of sea water, ocean topography and sampling techniques. Water masses. Air-sea interactions and water budgets. Ocean dynamics. Marine optics and remote sensing. Ocean Chemistry: Composition of sea water; Sea water as an electrolytic solution; The ocean carbon cycle; Macro- and micro-nutrients. Physical-Biological Coupling: Fluid motion and plankton at different scales; Aquatic photosynthesis; Biotic response to the vertical dynamics in the upper layer; The impact of physical processes on the biogeography of the ocean.	
Code:	**Semester: I**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: BIODIVERSITY AND MARINE BIOMONITORING	
Module: 1	**Plant biodiversity**
CFU:6	**SSD:BIO/01**
Teaching Hours: 40	**Hours of laboratory practice : 8**
Course year: first	
Goals: Acquisition of theoretical and applied tools for the identification and characterization of phototrophic eukaryotic biodiversity at evolutionary and phylogeographic level; geographical distribution of marine phototrophic organisms and their potential for evolutionary divergence	
Contents: The study of marine biodiversity is one of the attempt to capture the complexity of marine life, to promote its understanding and its maintenance. The course will cover different aspects of the diversity of the autotrophic components in the sea (from microalgae to macroalgae and to vascular plants), at various levels (populations, species and communities). We will elucidate how to monitor biodiversity, how changes in diversity influence functional properties of ecosystems, which indicators can be selected to monitor increasing anthropogenic pressures, including climatic changes.	
Code:	**Semester: I**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	
Module:2	**ANIMAL BIODIVERSITY**
CFU:6	**SSD: BIO/05**
Teaching Hours: 40	**hours of laboratory practice: 8**
Course year: first	
Goals: Acquisition of theoretical and application tools for the study of the structure and function of marine animal biodiversity at an evolutionary and ethological level. Acquisition of knowledge on the geographical distribution of populations of marine organisms. Knowledge of the theoretical and application tools of the main and most recent biomonitoring methods by identifying specific bioindicators and sentinel organisms to be used as early warning signs of degradation of marine ecosystems.	

Contents: Study of the evolution, distribution and interactions of and between animal organisms: I) reproductive, trophic and defense behavior; ii) structures, spatial and temporal dynamics, evolutionary history of animal populations. Census and biomonitoring methods
Attendance required: none
Didactic methods: practical and theoretical lessons
Didactic material: text books and didactic support on *docenti.unina* website
Type of Examination: Oral examination

Teaching: REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY OF MARINE VERTEBRATES	
Module: 1	
CFU:6	**SSD: BIO/06**
Teaching Hours: 40	**hours of laboratory practice: 8**
Course year: first	
Goals: Basic concepts of the reproductive strategies and the physiological and molecular processes involved in the reproduction and embryology of marine vertebrates..	
Contents Reproductive strategies in marine vertebrates: morpho-functional adaptations; Gametogenesis linked to hormonal and environmental control; embryology of the main taxa, characterization of the larval stage, bio/molecular mechanisms involved in ontogenetic processes	
Code:	**Semester: II**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: MARINE MICROBIAL BIODIVERSITY	
Module: 1	
CFU:6	**SSD:BIO/19**
Teaching Hours: 40	**Hours of laboratory practice : 8**
Course year: first	
Goals: Acquisition of the most relevant concepts for the identification and characterization of indigenous marine microorganisms and microbial communities.	
Contents: Microorganisms in the marine environments and a brief history of marine microbiology; Viruses, Bacteria, Archaea and Protists; Primary Production; Biogeochemical cycles and microorganisms; Diversity of marine environments; Major nutritional groups in the marine environment; Genome organization in marine prokaryotes; Bacterial and archaeal diversity in marine environments; Microbial communities in the marine environments; New Frontiers of Marine Microbial Diversity; Bioinformatic Laboratory; Sampling techniques in marine microbiology.	
Code:	**Semester: I**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: MARINE ECOLOGY AND PATHOLOGY	
Module: 1	**MARINE ECOLOGY**
CFU:6	**SSD:BIO/07**
Teaching Hours: 40	**hours of laboratory practice: 8**
Course year: first	

Goals: Knowledge of concepts relevant to structural and functional aspects of marine environment communities; ecology and population dynamics; modeling of marine ecosystems.	
Contents: The benthic organisms: the phytobenthos, the zoobenthos; benthos distribution; benthos study methods. Planktonic organisms: phytoplankton, zooplankton; plankton study methods. Nectonic organisms. Ecosystem functioning and productivity marine. Methods for the development of mathematical models to highlight and predict changes in the functioning of ecosystems.	
Code	**Semester: II**
Attendance required: none	
Didactic methods: lessons and exercitationes	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	
Module: 2	**MARINE PATHOLOGY**
CFU:6	**SSD: VET/03**
Teaching Hours: 40	**hours of laboratory practice: 8**
Course year: first	
Goals: Knowledge of Comparative pathology of aquatic animals; Basic Vertebrate and Invertebrates Immunity; most important infectious and non-infectious diseases of aquatic animals in aquaculture, aquarium systems and natural waters.	
Contents: Approach to the basis of General Pathology: Aetiology; Cellular Response to Stress; Cell Death (Apoptosis, Necrosis, Autophagy); Defensive Phenomena: Elements of Aquatic Vertebrates and Invertebrates Immunity: Haematopoietic tissues in Teleosts and comparative immunology of Invertebrates (Cnidaria, Crustaceans, Molluscs). Comparative Pathology of Inflammation: involved molecules and processes; Regressive phenomena: Atrophy and Cellular Degeneration; Progressive phenomena: Hypertrophy, Hyperplasia and Neoplasia; Aquatic Animal Diseases and environmental factors; Coral Diseases: (Coral bleaching, Black Band Disease, Aspergillosis); Mollusc OIE listed Diseases (Bivalves and Gastropods). Laboratory practice-Animal disease and diagnosis: Animal Sampling; Histopathology; DNA isolation and PCR; Light microscopy**.**	
Code:	**Semester: II**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: SCIENTIFIC ENGLISH	
Module:	
CFU:4	**SSD:**
Teaching Hours: 40	**hours of laboratory practice: 8**
Course year: first	
Goals: Knowledge of the syntactic structures and of the phraseology of scientific articles, aiming at improving written English in the field of marine biology.	
Contents:	
Code:	**Semester: I**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: PHYSIOLOGY OF MARINE ORGANISMS	
Module: 1	
CFU:6	**SSD: BIO/09**

Teaching Hours: 40	**Hours of laboratory practice: 8**
Course year: second	
Goals: Knowledge of the basis of physiological and behavioral mechanisms underlie the adaptation of the organisms to the marine environment.	
Contents: Basics in environmental physiology of animals. Thermal relations between animal and environment. Water and saline homeostasis in the aquatic environment. Buoyancy and locomotion in the marine environment. Perception in the marine environment.	
Code:	**Semester: I**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: BIOCHEMICAL ADAPTATION TO MARINE ENVIRONMENT AND BIOREMEDIATION	
Module: 1	
CFU: 6	**SSD: BIO/10**
Teaching Hours: 40	**hours of laboratory practice: 8**
Course year: second	
Goals: Advanced knowledge of proteins, enzymes their expression and characterization. Secondary metabolism and species specific enzymes.	
Contents: Function and structure of proteins, methods for determining protein structure and modeling. Principal concepts of enzymology. Michaelis Menten equation, derivation of kinetic parameters. Evolution and adaptation of proteins and enzymes. Primary and secondary metabolism. Enzymes of secondary metabolism as catalysts for green chemistry and bioremediation. Once these concept are introduced, we will proceed with a practical project that concerns the individuation of an enzyme able to metabolize a given chemical molecule from an environmental sample.	
Code:	**Semester: I**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: MARINE CONSERVATION GENETICS AND GENOMICS	
Module: 1	**CONSERVATION GENETICS**
CFU:6	**SSD:BIO/18**
Teaching Hours: 40	**hours of laboratory practice: 8**
Course year: second	
Goals: The theoretical portion of this course will cover the architecture of the genome in marine organisms, structure and dynamics of chromatin and transcriptional mechanisms of gene expression. In addition the basis of gene networks and metagenomic approaches will be given.	
Contents: Structure of coding genes in the genomic context. Structure of the transcripts and transcription regulators. Massively parallel sequencing of DNA and RNA. Next generation sequencing. Identification of regulatory non-coding regions using the histone code, ATAC-seq, and conservation during evolution. Study of regulatory regions in animal models. Transcriptomics in marine research to understand how marine organisms respond to environmental stress at the molecular level. Gene networks analysis. Metagenomic approaches for reconstructing the microbial communities that drive nutrient cycling in marine ecosystems. Bioinformatic methods and applications in marine biology: genome annotation and gene structure tools.	
Code:	**Semester: I**

Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	
Module: 2	**MARINE GENOMICS**
CFU:6	**SSD:BIO/11**
Teaching Hours: 40	**hours of laboratory practice: 8**
Course year: second	
Goals: The student should be able to elaborate a discussion on the chromatin structure and the transcriptional mechanisms of regulation of gene expression, and to master the most common experimental approaches and modern technologies that are used in the field of molecular biology of nucleic acids.	
Contents: Structure of coding genes. Regulation of transcription. Massive parallel sequencing. Structure of the nucleosome, epigenetics and histone code. Non-coding RNA. Introduction to bioinformatics. Genome editing. Comparison between genomes of marine organisms. Animal models. Practical course.	
Codice:	**Semester: I**
Attendance required: none	
Didactic methods: practical and theoretical lessons+	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Esami Opzionali

Teaching: ALGAL BIOLOGY	
Module: 1	
CFU:6	**SSD: BIO/01**
Teaching Hours: 40	**hours of laboratory practice: 8**
Type of activity: Compulsory module	
Goal: Knowledge and understanding, ability to learn, application skills and communication skills related to cytology, ultrastructure, reproduction, evolution and systematics of algal organisms.	
Contents: Study of the diversity and environmental significance of Algae. My approach is to use the taxonomic diversity of Algae as a framework to demonstrate their ecological and evolutionary significance. The underlying focus is to show the importance of Algae under environmental change. For this, we will use a combination of descriptive techniques, laboratory identification of invisible unicellular algae, and state-of-the-art quantitative methods. As the algae are very taxonomically complex, I teach the course according to their grouping. Special consideration will be given to conservation and climate change issues. Topics covered: History of Phycology and phylogenetics -Abiotic factors underlying Algal diversity; The Cyanobacteria - the bacteria that are Algae; Green Algae - the closest relative to land plants; Red Algae; Brown Algae; Euglenophytes; Chlorarachniophytes; Diatoms and Dinoflagellates; Biogeography of marine algae.	
Code:	**Semester: I**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: MANAGEMENT OF MARINE RESOURCES	
CFU: 6	**SSD: BIO/07**
Teaching Hours:	**hours of laboratory practice**

Type of activity: Compulsory module	
Goals: Acquisition of the essential knowledge to the management of marine resources.	
Contents: Basic statistical concepts: from univariate to multivariate; Univariate techniques; Multivariate techniques; Practical approach to ecological modelling: ecopath-ecosym; Marine Biology issues; Marine Ecology Issues; Biodiversity trends; Marine Resources; Sustainable use of marine resources. Biotic – abiotic; Marine Strategy, Marine Protected Areas, Conservation programs; New exploitation programs: drug mining and biotechnologies; How ecosystems work: food webs and plant-animal interactions; Food from the sea: Fisheries and Aquaculture; Mesocosms: a mean to understand complex systems; Management and conservation through Marine Protected Areas; VIA. Evaluation of environmental impacts.	
Code:	**Semester: II**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: SCUBA DIVING	
CFU:6	**SSD: BIO/01-05**
Teaching Hours: 40	**laboratory practice hours: 8**
Type of activity: Compulsory module	
Goals: Knowledge of the procedures and equipment for scuba diving ARA; Learning of safety and emergency maneuvers at sea.	
Contents: No-stop dive, ARA equipment (Regulators, Tanks, Jacket)	
Code:	**Semester: II**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: BIOGEOCHEMICAL CYCLES	
CFU: 6	**SSD: BIO/07**
Teaching Hours:	**Hours of laboratory practice:**
Type of activity: Compulsory module	
Goals: The student must be aware of the meaning of biodiversity and of the patterns and processes that lead to the functioning of ecosystems, linking biodiversity to ecosystem functioning. This will allow the student to fully understand the meaning of the Marine Strategy Framework Directive and of the eleven descriptors of Good Environmental Status therein. This knowledge is conducive to the application of an important EU Directive in the field of marine science.	
Contents: Philosophy of science: existential vs universal statements. Historical and a-historical disciplines. Predictability and intrinsic unpredictability. Chaos theory, the problem of the three bodies. Verbal models, graphic models, mathematical models, pictorial models. Definitions of biodiversity and its measurement. Definition of ecosystem structure and function. Patterns and processes. Links between ecology and evolution (Darwin). The fluxes of matter in ecosystems. Connectivity. The cells of ecosystem functioning. The Marine Strategy Framework Directive. The eleven descriptors of Good Environmental Status. The concept of sustainability and its attainment.	
Code:	**Semester: II**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Teaching: MARINE GEOLOGY	
CFU: 6	**SSD: GEO/03**
Teaching hours:	**Hours of laboratory practice:**
Type of activity: Compulsory module	
Goals: The student must demonstrate knowledge of the principles of tectonics, sedimentology and marine geophysics neededto understand submarine and subsurface data in the marine environment. It must be able to reprocess coring data, imaging (seismic and acoustic) and cartographic data for the environmental, depositional and structural reconstructions of ocean bottoms in environments with passive and convergent margins.	
Contents: Plate Tectonics and large scale earth processes. Mid Ocean Ridges, Subduction Zones, Plate Tectonic Cycle, Driving mechanisms. Sea Level changes. Sedimentology and sedimentary processes. Different types of sediments in the ocean basins and on their margins. Sediment processes - cohesive and non-cohesive sediments. Bedforms. Deltas. Estuaries. Tidal Flats. Continental Shelves. Coastal Processes. Deep sea sedimentation. Techniques for observing the ocean basins. Broad introduction to different techniques then focus on acoustic techniques. Seismic reflection. Multibeam bathymetry, and Sidescan sonar.	
Code:	**Semester: II**
Attendance required: none	
Didactic methods: practical and theoretical lessons	
Didactic material: text books and didactic support on *docenti.unina* website	
Type of Examination: Oral examination	

Calendar of educational activities - a.a. 2019/2020

	Inizio	Termine
1° didactic period	23 September 2019	18 December 2019
1° examination period	07 January 2020	06 March2020
2° didactic period	09 March 2020	12 June 2020
2° examination period	15 June 2020	31 July 2020
3° examination period	02 September 2020	30 September 2020

1st semester holidays: All Saints Day: Friday 1st November; Christmas: from Monday 23 December to Monday 6 January.
Carnival holidays: from Monday 24 February to Tuesday 25 February.
2nd semester holidays: Easter: from Thursday 09 April to Wednesday 15 April; Labor Day: Friday 1 May.

For current students it is expected:
• an extraordinary appeal for the recovery of the exams in debt in the first fifteen days of the month of October;
• an extraordinary appeal for the recovery of debit exams in the first fifteen days of March

For student who has not completed university exams within set time period of the course exams are held:

a) in the summer session in May, June and July,
b) in the autumn session in September, October and December,
c) in the extraordinary session in January, February and March.

Contact of the Master

Educational Coordinator of the Master's Degree Course in Biology and Ecology of the Marine Environment and Sustainable Use of Marine Resources
Prof.ssa Anna Di Cosmo – Dipartimento di Biologia - tel. 081-679058, – e.mail: dicosmo@unina.it

Contact person for the Degree Program for the SOCRATES / ERASMUS Program:
Prof. GianlucaPolese – Dipartimento di Scienze Biologiche - tel.081-679188
e-mail: gianluca.polese@unina.it

Any special provisions

The course of study has received for the A.A. 2015/16, 2016/17, 2017/18, 2018/19, and 2019/20 the assignment of grants for the mobility of "in coming" and "out going" students and Visiting Professors by the Compagnia di S. Paolo in the field of the project "Internationalization of Study Courses" www.coinor.unina.it, as well as scholarships under the "Partnership for Knowledge" program of the Italian Agency for Cooperation and Development, Ministry of Foreign Affairs.