UNIVERSITY OF L'AQUILA

Department of Health, Life and Environmental Sciences

1st Cycle Degree in BIOLOGICAL SCIENCES

Laurea in SCIENZE BIOLOGICHE

Course Catalogue

Academic year starts the last week of September and ends the first week of June.
1st Semester - *Starting date:* last week of September, *end date*: 3rd week of January
2nd Semester - *Starting date:* last week of February, *end date:* 1st week of June
Exams Sessions: I) from last week of January to 3rd week of February, II) from 2nd week of June to end of July, III) from 1st to 3rd week of September

Comprehensive Scheme of the First Cycle Degree in BIOLOGICAL SCIENCES				
YEAR	**CODE**	**COURSE**	**Credits (ECTS)**	**Semester**
I	F0036	General and Inorganic Chemistry	6	1
	F0066	Cellular Biology	6	1
	F0166	Mathematics	9	1
	F0102	Botany	9	2
	F0104	Zoology	9	2
	F1155	Organic Chemistry	9	2
	F0168	Physics	6	2
	F1151	*English Language Level A2*	3	1 and 2
II	F0044	Developmental Biology	6	1
	F0093	Biochemistry	9	1
	F0113	Genetics	9	1
	F1189	Histology	6	1
	F0048	Laboratory of Microscopic Techniques	2	2
	F0071	Comparative Anatomy and Anthropology	9	2
	F0108	Microbiology	6	2
	F1150	*Free choice Courses*	6	1 and 2
III	F0082	Ecology	9	1
	F0211	Principles of General Pathology and Immunology	6	1
	F0122	Laboratory of Cell and Molecular Techniques	2	1
	F0059	General Physiology	9	1
	F0119	Molecular Biology	9	2
	F0172	Applied Cellular and Molecular Methods	2	2
	F0125	Plant Physiology	9	2
	F0171	General Pharmacology and Toxicology	6	2
	F1150	*Free choice Courses*	6	1 and 2
	F0097	*Internship*	3	1 and 2
	F0103	*Thesis*	5	2
Suggested Optional Courses				
II or III	F1149	Laboratory of Informatics	4	1

Programme of "CHIMICA GENERALE E INORGANICA" *"GENERAL AND INORGANIC CHEMISTRY"*		
F0036, compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 1st year, 1st semester**		
Number of ECTS credits: 6 (total workload is 200 hours; 1 credit = 25 hours)		
Teacher: Massimiliano ASCHI		
1	Course objectives	The goal of this course is to provide the students with the basis of the stoichiometry and general chemistry. On successful completion of this module, the student should be able of solving any simple stoichiometric calculation and should be familiar with the elementary concepts of the structure of the matter and chemical equilibrium preparatory for the organic chemistry and for all the disciplines based on biochemistry and molecular biology
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Structure of the atom, periodic properties and the periodic table, - Chemical bond and molecular structure, weak interactions, gas, liquids and solids, laws of thermodynamics, - Chemical equilibrium between pure species and in solution, properties of the solutions, short background in electrochemistry and chemical kinetics. - All the basic stoichiometry. On successful completion of this module the student should o have sufficient knowledge of the structure of the matter; o be able to predict the structure of any molecule and the hybridization of the related atoms; o be able to provide the name of the most common chemical substances; o have knowledge and understanding of the principles of chemical equilibrium; o demonstrate skill in the solution of the stoichiometry problems; o demonstrate capacity to be critical and self-critical.
3	Prerequisites and learning activities	The student must know the basic notions of mathematics and, possibly, of elementary physics.
4	Teaching methods and language	Lectures. Language: Italian and English Ref. Text books : The student can select one of these books: • Peter W. Atkins and Loretta Jones *"Principi di Chimica"* Zanichelli Editore • John Kotz, Paul jr. Treichel, Gabriela C. Weaver *"Chimica"*, Edises • Maurizio Casarin, e altri *"Chimica Generale ed Inorganica"*, EdiErmes
5	Assessment methods and criteria	Written and oral exam.

Programme of "BIOLOGIA CELLULARE" *"CELL BIOLOGY"*		
F0066, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 1st Year, 1st Semester**		
Number of ECTS credits: 6 (workload is 150 hours; 1 credit=25 hours)		
Teacher: Annamaria CIMINI		
1	Course objectives	The goal of this course is to provide the students with scientific notions on prokaryotic and eukaryotic cells, starting from the levels of organization arriving to the biological basis of differentiation and cell division. Also some notions regarding gametogenesis, stem cells and cell culture are provided. On successful completion of this module, the student should be aware of the structure of eukaryotic cell, of the fundamental importance of compartimentalization and of the close relation between shape/function.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: -The levels of organization of biological systems; prokaryotic and eukaryotic cells; the cell membrane: structure and functions; -The membrane transport systems; endocytosis and esocytosis; The plant wall; the cell junctions: thight and gap junctions, desmosomes and adherent junctions; the extracellular matrix; -The nucleus: DNA, histones; nucleosome, chromatin;The endoplasmic reticulum: Smooth

		and Rough; protein glycosilation; ribosomes; protein synthesis; the Golgi Apparatus; Lisosomes; peroxisomes; mitochondria; chloroplasts; cytoskeleton: microtubules; intermediate filaments; microfilaments; cell cycle: phases and control; mitosis; meiosis; gametogenesis; stem cells; cell cultures. On successful completion of this module the student should o have profound knowledge of cell Biology; o have knowledge and understanding of the principal biological fundaments of eukaryotic cells. o be able to explain the biological fundaments of cell function o demonstrate skill in find connections and ability to perform biological tests o demonstrate capacity for reading and understand other texts on related topics. o be able to apply the acquired knowledge to concrete cases as occurring in the professional life; o demonstrate concern to health, well-being and safety; o be able to work in team showing commitment to tasks and responsibilities o demonstrate capacity to be critical and self-critical
3	Prerequisites and learning activities	The student must know the basic notion of Physics and Chemistry
4	Teaching methods and language	Lectures. Language: Italian/English Ref. Text books • E. Olmo, *"Biologia della Cellula"*, Edi-Ermes • Becker A., "*il Mondo della cellula*" Casa Editrice EdiSES • G. Karp, "Biologia Cellulare e Molecolare" Casa Editrice EdiSES
5	Assessment methods and criteria	Written exam (test with multiple choice)

Programme of "MATEMATICA" ***"MATHEMATICS"*** **This course is composed of two Modules: 1) Basic Mathematics, 2) Integrative Mathematics**		
F0166 , compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 1st Year, 1st Semester**		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit = 25 hours)		
1) BASIC MATHEMATICS (6 ECTS)		
Teacher: Lucio BEDULLI		
1	Course objectives	The goal of this Module is to provide the students with the basic tools of Mathematics for the quantitative interpretation and analysis of natural phenomena.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - The language of mathematics: naïve set theory. - Elementary real functions: polynomials, roots, exponential, logarithmic and trigonometric functions. - Analysis of functions of one real variable: limits, differentiation and integration. - Elementary differential equations. - Systems of linear equations, matrices and linear geometry of the 2D and 3D space. On successful completion of this module, the student should o develop logical thinking, power of abstraction and generalization; o fully understand the language of mathematics used in natural sciences; o have profound knowledge of the mathematical analysis of real functions modelling natural phenomena; o understand and explain in correct terms the geometry and underlying symmetries of phenomena. o demonstrate skill in selecting and using appropriate mathematical strategies and techniques;

		o be able to solve problems using mathematics in unfamiliar settings, and explain why mathematical thinking is valuable in biological setting as well as in daily life.
3	Prerequisites and learning activities	The student must have a solid background in algebra (manipulating polynomials, equations and inequalities with rational and real numbers) and know the basics of elementary Euclidean geometry.
4	Teaching methods and language	Lectures and exercises. Language: Italian/English Ref. Text books: • Di Benedetto D., Degli Esposti M., Maffei C.: "*Matematica per le Scienze della Vita*" , CEA,2012 • M. Garetto: "*Statistica: Lezioni ed esercizi*" available online at http://www.dm.unito.it/quadernididattici/garetto/quaderno_statistica.pdf
5	Assessment methods and criteria	Written and oral exam.
2) INTEGRATIVE MATHEMATICS (3 ECTS)		
Teacher: Murizio SERVA		
1	Course objectives	The goal of this module is to provide the students with mathematical knowledge and tools enabling them to analyze real data coming from physics, chemistry, human sciences and, above all, biology, using statistical methods.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Descriptive statistics: graphs, mean and variance. Correlation between variables and linear regression. - Probability: random experiments, sample space, events. Combinatorics. Axiomatic definition of probability. Conditional probability. Bayes' theorem . - Random variables: probability distributions and probability densities. Binomial, Poisson, Gauss and uniform distributions. - Sample theory: distributions of the average and of the variance. On successful completion of this module, the student should o Demonstrate basic knowledge of classic probability theory and of the most common probability distributions, o Know and understand univariate and multivariate standard descriptive statistics, o Be able to critically assess causalities from correlations and (multiple) regressions; o Be able to use tools of statistics and probability to organize data, extract the essential information and infer the relevant parameters. o Be able to critically evaluate the design, including sampling techniques, of a statistical study, o Be able to model and analyze measurement data using the appropriate distribution, e.g. normal, binomial, chi-square, o Be able to construct and interpret confidence intervals to estimate means and proportions for populations, and o Be able to apply the acquired abilities to critically review articles from current newspapers , journals, and other published material.
3	Prerequisites and learning activities	The student must have a solid background in algebra (manipulating polynomials, equations and inequalities with rational and real numbers) and know the basics of elementary Euclidean geometry.
4	Teaching methods and language	Lectures and exercises. Language: Italian/English Ref. Text books: • Di Benedetto D., Degli Esposti M., Maffei C.: "*Matematica per le Scienze della Vita*" , CEA,2012 • M. Garetto: "*Statistica: Lezioni ed esercizi*" available online at http://www.dm.unito.it/quadernididattici/garetto/quaderno_statistica.pdf
5	Assessment methods and criteria	Written and oral exam.

Programme of "BOTANICA" *"BOTANY"*		
F0102, **Compulsory** **1st Cycle Degree in BIOLOGICAL SCIENCES, 1st Year, 2nd Semester**		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit=25 hours)		
Teacher: Giuseppe CHICHIRICCÒ		
1	Course objectives	The goal of the course is to provide the knowledge of the different organization levels of the plants and their evolutionary paths by studying their cytology, histology, anatomy and reproductive systems, stressing the relationships between structure and function. The final part of the course will be devoted to the systematic of flowering plants
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: Origin of life and evolution of plants. Structure, properties and functions of plasma membrane, tonoplast, vacuole, cell wall, plastids, cytoskeletal systems, peroxisomes. Growth, morphogenesis and differentiation. Cellular aggregations. Asexual and sexual reproduction. Algae, general characters and reproductive cycles. Evolutionary trends. Emergence from the water and origin of land plants. Histology, anatomy and development of the root, stem and leaf. Evolution of vascular plants. Extant vascular cryptogams. Origin and evolution of seed plants, the reproductive systems. Progimnosperms and extant gimnosperms. Angiosperms. Classification of flowering plants. Practical exercises will be done by the students as laboratory experience. On successful completion of this module the student should o have knowledge of cell biology and understanding of the biological fundaments of the growth and differentiation, o know the principal fundaments and functions of the cellular aggregations, tissues and organs and understand the chemical and molecular bases of living systems, o have knowledge and understanding of the plant reproductive systems and their evolutionary trends, o demonstrate skill in find connections and ability for morphological and structural analysis of plants, o Understand the structure and functions of plants, how they interact with other organisms, and how they function within ecological and global systems. o Recognize the scope of biological diversity, and understand how evolution generates that diversity and associated adaptations, o demonstrate concern to health, food and environment, o be able to apply the acquired knowledge to concrete cases and to interpret scientific articles on related topics, o be able to work in team showing commitment to tasks and responsibilities.
3	Prerequisites and learning activities	The student must know the basic notion of Physics and Chemistry
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books • Pasqua G., Abbate G., Forni C. *Botanica generale e diversità vegetale*. Piccin • Gerola M. et al. *Biologia e diversità dei vegetali*. Utet • Mauseth J.D. *Botanica, parte generale*. Idelson Gnocchi
5	Assessment methods and criteria	Written examination, oral on request

Programme of "ZOOLOGIA" *"ZOOLOGY"*		
F0104, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 1st Year, 2nd Semester**		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit= 25 hours)		
Teacher: Maurizio BIONDI		
1	Course objectives	To inspire and encourage an interest in zoology. To acquaint students with evolutionary principles and animal diversity. To instill in students an understanding and appreciation for the animals which share our

		planet. To make students aware of the various disciplines encompassed by the field of zoology and to encourage them to pursue those areas that interest them through further reading and coursework. To encourage the development of inductive and deductive reasoning and to promote better study and test-taking skills necessary for this and other courses.
	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: Levels of animal organization. Sexuality and asexuality in animals. Agamic reproduction. Amphigony and parthenogenesis. Different types of hermaphroditism. Patterns of criptism and mimetism. History of the species concepts. Mechanism of reproductive isolation. Brief history of evolution theory. Macroevolution and microevolution. Modes of speciation. Genetic drift. Classification and identification. The taxonomic categories. Aims of the animal systematics. Analogy and homology. Adaptive convergence. Main morphological characteristics, levels of organization and phylogeny of the animal phyla. On successful completion of this module the student will: o Demonstrate understanding of the importance of taxonomy and the biodiversity of fauna and their conservation. o Acquire knowledge and understanding of comparative structure and function of the different organ systems and their physiological importance in relation to habit and habitat of the organism, with special regard to the reproductive strategies. o Acquire advanced knowledge on different aspects of evolutionary zoology such as speciation modes, phylogeny methods, types of natural selection and so on. o Be able to appreciate the complexities of biological organisation and be able to address scientifically controversial issues in a rational way. o Be able to interpret material in terms of biological function and the effect of natural selection. o Be able to analyse and report on material learned. o Be able to assess the scope of animal biology and be able to select particular areas for further study. o Be aware of the breadth of studies on the biology of animals as they relate to the evolution, function, behaviour and behavioural ecology of animals. o Be able to integrate related topics from separate parts of the course. o Have adequate knowledge of the animal systematics for pursuing advanced studies in various fields of animal sciences by research.
3	Prerequisites and learning activities	The student must have basic notion of the general biology and genetics.
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books • Hickman C.P., Roberts L.S., Larson A., l'Anson H., *Fondamenti di Zoologia*, McGraw-Hill • Hickman C.P., Roberts L.S., Larson A., *Diversità animale*, McGraw-Hill • Balletto E., *Zoologia evolutiva*, Zanichelli (chapters 16-17; 22-23) • Ferraguti M., Castellaci C., *Evolutiva*. Modelli e processi. Pearson Italia Editrice (chapters 11-12)
5	Assessment methods and criteria	Oral or written exam

Programme of "CHIMICA ORGANICA" "*ORGANIC CHEMISTRY*"		
F1155, Compulsory 1st Cycle Degree in BIOLOGICAL SCIENCES, 1st Year, 2nd Semester		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit = 25 hours)		
Teacher: Fabio MARINELLI		
1	Course objectives	The goal of this course is to provide knowledge of basic organic chemistry, focusing also on biomolecules (carbohydrates, aminoacids, lipids)

2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Chemical bonding. Molecolar geometry. Functional groups. - Acids and bases. pK_a. Hydrocarbons. Isomers. Conformations. - Reaction mechanisms. Energy diagrams. Reaction rate. Reactions of alkenes: electrophilic addition - Stereochemistry: enantiomers and diastereomers. - Alkyl halides. Nucleophilic substitutions and eliminations - Alcohols, eters and tiols.. Reactions. Epoxide ring opening. - Benzene and aromaticity.. Electrophilic aromatic substitution. - Amines. Basicity and nucleophilicity of amines. - Aldehydes and ketones. Nucleophilic addition. - Carboxylic acids. Acidity. Acyl derivatives. Nucleophilic acyl substitution. Enolate anions. - Polymers. Step-growth and chain-growth polymerization. - Carbohydrates: Fischer projection. Aldoses and ketoses. Disaccharides. Polisaccharides - Aminoacids. Fischer projection. Acid-base equilibria. Isoelectric point. Titration curves. Peptide bond. - Lipids: triglycerides. Fatty acids. Surfactants. On successful completion of this module the student should o have a knowledge of nomenclature, structure and properties of functional groups, and a basic knowledge of stereochemistry and conformation of organic molecules, o Be able to describe organic molecules in terms of bonding, stereochemistry, functional groups, and resonance, o have a knowledge and understanding of the most important reaction mechanisms. o Be able to derive the intermolecular force of given molecules based on their chemical structures, o Be able to draw and represent organic molecules, using arrow notation to show the movement of electrons, o demonstrate ability in resolution of simple problems . o have capacities of understanding the chemical properties of carbohydrates, aminoacids, lipids. o Demonstrate proficiency in identifying various classes of reactions (i.e. addition, elimination, arrangements).
3	Prerequisites and learning activities	The student must know basic notions of General Chemistry (exam of Chimica Generale ed Inorganica)
4	Teaching methods and language	Lectures and practical exercise. Language: Italian Ref. Text books: • Brown, Poon: *Introduzione alla Chimica Organica*, EDISES, IV ed (2012).
5	Assessment methods and criteria	Written and oral exam

Programme of "FISICA" **"*PHYSICS*"**		
F0168 , Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES , 1st Year, 2nd Semester**		
Number of ECTS credits: 6 (workload is 150 hours; 1 credit=25 hours)		
Teacher: Libero PALLADINO		
1	Course objectives	The aim of the course is to introduce the physical concepts that are the basis the behavior of biological systems. For example, the properties of liquids, the interaction of EM radiation with biological structures, Brownian motion and its link with the thermal agitation and diffusion processes. Furthermore, the purpose of the part of the laboratory is to introduce: a) the measurement process and the relative statistical analysis b) the use of computers in the analysis of experimental data.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Principles of mechanics, Conservation laws, Principles of thermodynamics, Brownian motion, Physics of fluids, Principles of electricity and magnetism, Geometrical and wave optics.

		On successful completion of this module the student should o have profound knowledge of physics; o have knowledge and understanding of physical laws applied to biological mechanisms; o be able to explain the relevant topics and methods using appropriate scientific language; o be able to apply the acquired knowledge to concrete cases as occurring in the professional life; o demonstrate concern to health, well-being and safety; o be able to work in team showing commitment to tasks and responsibilities o demonstrate capacity to be critical and self-critical.
3	Prerequisites and learning activities	The student must know the basic of Arithmetic, Algebra, geometry and mathematical analysis
4	Teaching methods and language	Lectures and exercises. Language: Italian Ref. Text books: -Halliday Resnick – *Fisica* – Editrice Ambrosiana -Memos and notes
5	Assessment methods and criteria	Written and Oral exam

Programme of "BIOLOGIA DELLO SVILUPPO" "*DEVELOPMENTAL BIOLOGY*"		
F0044 , Compulsory 1st Cycle Degree in Biological Sciences, 2nd Year, 1st Semester		
Number of ECTS credits: 6 (workload is 150 hours; 1 credit = 25 hours)		
Teacher: Maria Paola CERÙ		
1	Course objectives	The aim of the course is to give informations about the phenomena involved in animal development, i.e. gametogenesis, fertilization, embryonic development stages, organogenesis included, with particular attention to vertebrates. Examples of important animal models among invertebrates, i. e. sea urchin and *Drosophila melanogaster* are also given. The overall *fil rouge* of the course is the evolution of the developmental processes in relation with the developmental environment. At the end of the course, students will be familiar with the fundamental processes of animal development and their phylogenetic relationships, necessary, on one hand, to go on in the subsequent Course of Comparative Anatomy, and, on the other hand, to understand the cellular and molecular mechanisms underlying developmental processes, treated in the more advanced Couse of Molecular cell and developmental biology.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: Meiosis and mitosis; gametogenesis: spermatogenesis and ovogenesis; structures of testis and ovary; hormonal control of gametogenesis; fertilization: the sea urchin (external) and the mammalian (internal) examples; stages of embryonic development: segmentation, gastrulation, neurulation and organogenesis;comparative embryology: sea urchin, Drosophila, fishs, amphibians, birds and mammalians; embryonic annexes: yolk sac, amnios, corion, allantois and placenta; organogenesis of ectodermal, mesodermal and entodermal organs and *apparati* of vertebrates On successful completion of this module, the student should: o acquire knowledge of the fundamental processes of development and understanding of the importance of the environment either in the developmental phylogenesis and ontogenesis; o be able to apply knowledge and understanding to following Courses; o be able to make informed judgments and choices in each own working life; o be able to communicate knowledge and understanding to other people; o have capacity to continue learning, deepening the topics of the Developmental Biology; o have profound knowledge of developmental processes; o have knowledge and understanding of basic mechanisms underlying developmental processes and of the influence of the environment on the evolution of such processes and on the correct execution of the developmental program;

		o be able to explain the fundaments of developmental processes; o demonstrate skills in finding connections between cell biology and comparative anatomy and ability to perform biological tests; o demonstrate capacity for reading and understand other texts on related topics; o demonstrate concern to health, well-being and safety; o be able to work in team showing commitment to tasks and responsibilities
3	Prerequisites and learning activities	The student must know basic cell biology and histology and, possibly, zoology.
4	Teaching methods and language	Lectures, team work, exercises, home work. Language: Italian/English Text books: -Le Moine e Foucrier, *"Biologia dello sviluppo*" , EdiSes. -Franquinet e Foucrier, "*Embriologia descrittiva*" , EdiSes. -Gilbert, "*Biologia dello sviluppo"*, Zanichelli.
5	Assessment methods and criteria	Oral exam

Programme of "BIOCHIMICA" ***"BIOCHEMISTRY"***		
F0093, Compulsory, **1st Cycle Degree in BIOLOGICAL SCIENCES, 2nd Year, 1st Semester**		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit=25 hours)		
Teacher: Giuseppina PITARI		
1	Course objectives	Biochemistry combines the study of the biology and chemistry of living organisms to allow us to understand the molecular basis of life. These studies cover life forms from bacteria to plants and animals and humans in healthy and diseased states. This module aims to introduce the molecular basis of cellular processes and the principles that underlie many biological events. Consideration is given to the implications in relation to health and disease.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Proteins: Proteins and their building blocks; Proteins in health and disease; Enzymes kinetics and regulation; Protein purification. Roles and structures of carbohydrates, lipids, vitamins, hormones. - Energy and cellular metabolism: glycolysis; TCA cycle; oxidative phosphorylation; gluconeogenesis; glycogen metabolism; fat metabolism; basic amino acid metabolism. On successful completion of this module, the student should o have profound knowledge of protein biochemistry o have knowledge and understanding of the chemistry of life o understand and explain molecular basis of cellular processes o demonstrate skill in metabolic pathways and ability to connect biochemical processes o demonstrate capacity for reading and understand health implication.
3	Prerequisites and learning activities	The student must know cellular biology, general and organic chemistry
4	Teaching methods and language	Lectures, exercises, home work, experimental. Language: Italian -Nelson David L., Cox Michael M., "*Principi di Biochimica"* -Voet, Voet e Pratt, "*Fondamenti di Biochimica*"
5	Assessment methods and criteria	Oral exam

Programme of "*GENETICA*" ***GENETICS***
F 0113 , Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 2nd Year, 1st Semester**
Number of ECTS credits: 9 (workload is 225 hours; 1 credit=25 hours)

Teacher: Michele MIRANDA		
1	Course objectives	The goal of this course is to provide the students with the today basic knowledges of general Genetics in order to study Biochemical Genetics, population genetics, Ecology, Genetic engineering and genomics.
2	Course content and Learning outcomes (Dublin descriptors)	Course content: The genetics: fields of investigation and applications. The chemical nature of genes: DNA; RNA, Chromosomes and genophores. Genotype, phenotype and environment. The replication of genes. The transmission of genes: Mendelism. Pedigrees. Morgan, linkare and genetic maps. Genetic recombination and molecular mechanism of Crossing-over. Fine structure of the genes: Benzer. Colinearity gene-proteins: Transcription-Translation and genetic code. Mutations and genetic variability. Gene chromosomal and genomic mutations. Cytoplasmic heredity. The population genetics and Hardy-Weinberg law. On successful completion of this module the student should o have basic knowledge of genetics; o have knowledge and understanding of the major issues of genetic heredity; o be able to explain the acquired knowledge by using the technical language; o demonstrate capacity for reading and understand other texts on related topics; o be able to apply the acquired knowledge to concrete cases such as pedigrees, genetic forecasting; o demonstrate concern to health, well-being and safety; o demonstrate capacity to be critical and self-critical
3	Prerequisites and learning activities	The student must know the basic notion of organic, chemistry, cytology, embryology, mathematics.
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books: • J.D. Watson - *Biologia molecolare del gene* Vol. I e II (Zanichelli) • R.E. Scossiroli; D.L. Palenzona - *Manuale di Biometria* (Zanichelli) – • M.R. Spiegel - *Statistica* (Collana Shaum) • Robert J. Brook'er - *Genetica* (Zanichelli) • J. F. Griffiths, JH. Miller, D. T. Suzuki, R. C. Lewontin, W-M Gelbart *Genetica Principi di analisi formale* (Zanichelli) - • Peter Russel' *Genetica* , EDISES ed. (ultima edizione). • Hartwell,Hood,Goldberg,Reynolds,Silver,Veres.*Genetica dall'analisi formale alla genomica*. McGraw-Hill
5	Assessment methods and criteria	oral exam

Programme of "ISTOLOGIA" ***"HISTOLOGY"***	
F1189, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 2nd Year, 1st Semester**	
Number of ECTS credits: 6 (workload is 150 hours; 1 credit = 25 hours)	
Teacher: Mara MASSIMI	
1 Course objectives	The objective of this course is to provide students with an understanding of normal histological structure of the different tissues of vertebrate body, primarily concentrating on mammalian tissues. Emphasis is placed on the interactions of cells with one another as components of tissues and organs as well as on the correlations between tissue function and structure.
2 Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: The concept of tissue. Basic techniques for histological studies. Histological differentiation. Embryologic origin of tissues. Tissue types and their classification. Cellular and extracellular components. Interactions between tissues in the establishment of organs and systems. Epithelial, secretory and sensory tissues. Endocrine and exocrine glands. Connective tissues: amorphous ground substance and fibers, cellular component. Proper connective tissue. Support connective tissues: cartilage and bone. Ossification processes. Blood and emopoiesis. Adipose tissue. Lymphoid tissue. Smooth, striated, skeletal and cardiac muscle tissue. Nervous tissue: neurons, neuroglia cells, nerve fibers. Myelination process. Structure and organization of nerves. Synapses and myo-muscular junctions.

		On successful completion of this module, the student should: o have profound knowledge of the normal structure of various cell types and tissues. o have knowledge and understanding of the organization of the four basic tissue types. o understand and explain how their structure and function are related o be able to identify and describe normal tissue types and histological structures on practical examinations (microscope slides or micrographs). o demonstrate skills in the main histological techniques and be able to explain the physical and chemical bases of the different procedures.
3	Prerequisites and learning activities	The student must have a solid background in Cell Biology.
4	Teaching methods and language	Lectures. Language: Italian / English Ref. Text books: • Colombo R.and Olmo E., " *Biologia dei Tessuti* ", Edi-Ermes • Young B. & Heath J.W. , "*Istologia e Anatomia Microscopica",* Casa Editrice Ambrosiana • Gartner L.P. & Hiatt J.L., "*Istologia",* EdiSES
5	Assessment methods and criteria	Written and oral exam.

Programme of "LABORATORIO DI TECNICHE MICROSCOPICHE" **"*LABORATORY OF MICROSCOPIC TECHNIQUES*"**		
F0048 Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 2nd Year, 2nd Semester**		
Number of ECTS credits: 2 (workload is 50 hours; 1 credit=25 hours)		
Teachers: Giordana MARCOZZI and Loretta Giuseppina PACE		
1	Course objectives	The goal of this course is to provide the student with the principal rules and safety procedures to work in a biological laboratory. It consists in two parts. The lectures will discuss the theory and techniques that relate to the experiments that are performed. In the laboratory part the student acquires the rudiments in the preparation of samples of various biological tissues for their observation by light microscopy.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module includes: *First part*: preparatory access in the lab, rules and safety procedures to be observed in a laboratory: risk assessment, signage and other hazards, MSDS of the products, chemical and biological risks. *Second part*. Microscopic techniques. - Preparation of histological sections. Principles of operation and use of the light microscope. Direct measurements and microscopic morphological analysis. Microscopic observations of various biological samples. - Preparations with a fresh plant material. Methods for the highlight of the cell walls and chromosomes. - Staging and dissection of zoological specimens in stereomicroscopy purposes of taxonomic identification. Analysis of zoological specimens in stereomicroscopy and light microscopy with reference to the main structural plans of terrestrial and aquatic invertebrates. On successful completion of this module the student should - have knowledge of the risks present in the chemical and biological laboratory; - have knowledge and understanding of the principal behaviors during laboratory activities, and the procedures to be followed in danger situations; - have knowledge and understanding of common microscopic morphological analysis; - be able to explain the relevant techniques in diagnostics using appropriate scientific language; - demonstrate skill in the use of the light microscope; - demonstrate capacity of recognition of different biological tissues and main zoological phyla using diagnostic keys; - be able to work in team.

3	Prerequisites and learning activities	The student must know the basic of cellular biology.
4	Teaching methods and language	Lectures and laboratory team work. Language: Italian Ref. Text books: Teacher's lecture notes. Monographs, atlases zoological and botanical provided by teachers . websites: http://vigilidelfuoco.it; http://diario-prevenzione.it/; www.ispesl.it www.univaq.it/sicurezza/rischio_biologico
5	Assessment methods and criteria	Multiple choice short answered questions written exams

Programme of "ANATOMIA COMPARATA ED ANTROPOLOGIA" ***"COMPARATIVE ANATOMY AND ANTHROPOLOGY"*** **This course is composed of two Modules: 1) Comparative Anatomy, 2) Anthropology**		
F0071, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 2nd Year, 2nd Semester**		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit= 25 hours)		
1) COMPARATIVE ANATOMY (6 ECTS)		
Teacher: Laura CONTI DEVIRGILIIS		
1	Course objectives	The goal of this Module is to provide the students with rational and scientific bases for a critical study of the structural/functional relationships of organs and systems of the vertebrates. Taxonomy, evolutionary relationships and morphological adaptations of fish, amphibians, reptiles, birds and mammals are emphasized.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - General principles of Comparative Anatomy: morphology and function; evolution and adaptation; environment-organism interactions; relationship between ontogeny and phylogeny. Taxonomy. Principles of cladistic classification. - Chordate and Vertebrate classification. Agnata, Chondrichthyes, Osteichthyes, Amphibia, Amniota: Sauropsids and Synapsids. - Knowledge of the anatomy of vertebrate apparatuses: tegumentary, skeletal, muscular, digestive, respiratory, urogenital and nervous systems. On successful completion of this module the student should - have knowledge and understanding of the general principles of the phylogeny, taxonomy, systematic and their significance; - have profound knowledge of human evolutionary history; -have profound knowledge of non-human primates evolutionary history; -have knowledge and understanding of the biological analyses; - be able to explain the differences between the taxa of Chordates on the basis of evolutionary biology, using appropriate scientific language; - demonstrate skill in recognition of organs and tissues of Vertebrates and ability to emphasize morphological similarities and differences by means of comparative analysis ; - demonstrate skill and ability in analytical evaluation of the techniques; - demonstrate capacity for reading and understand other texts on related topics; - be able to integrate the acquired knowledge with similar teaching subjects to improve own basic biologic background; -be able to apply the acquired knowledge to concrete cases -be able to work in team -demonstrate capacity to be critical and self-critical.
3	Prerequisites and learning activities	The student must know the basic notions of Cell Biology, Histology and Developmental Biology, moreover he must know the basic notion of Anthropology.
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books • K. V. KARDONG. " *Vertebrati: anatomia comparata, funzione, evoluzione*" Ed. McGraw-Hill

		• K. F. LIEM, W.E. Bemis, W.F. Walzer, L. Grande "*Anatomia comparata dei Vertebrati : una visione funzionale ed evolutiva",* EdiSES • G. Biondi & O. Rickards, *Umani da sei milioni di anni*, Carocci Editore, Roma.
5	Assessment methods and criteria	Written and oral exam; written text exam
2) ANTHROPOLOGY (3 ECTS)		
Teacher: **Gianfranco BIONDI**		
1	Course objectives	The aim of the anthropology Module is to provide the students with rational and scientific bases of the evolutionary process of the history of human species and the other non-human primates, through the application of correct methodologies in morphology and molecular analysis. On successful completion of this course, the student should be aware of the interfering factors relates to the evolution of humans and non-human primates.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Basis of the principal analytical techniques used (morphological analysis of fossils, dating methods of fossils, archaeological methodology, DNA analysis: mitochondrial and nuclear). - Overview of human skeleton: cranial skeleton, axial skeleton and thorax, appendicular skeleton, osteology, odontology, comparison with non-human skeletal form. - Theory underlying recovery scene methods: observational, geophysical and chemical; study of archaeology of mass graves. Personal identification: determination of age, sex, attribution of ancestry; skeletal markers of activity and life history. - History of evolutionary theory and history of anthropology. On successful completion of this module the student should o understand the basic concepts associated with each system of the body; o be able to identify structures that are in place in the body systems to perform the functions according to the habits or habitats of the animals; o understand how the components of the body systems evolved when the animals moved from one habit and/or habitat to another to meet the requirements of the new environment; o have profound knowledge of non-human primates evolutionary history; o be able to examine a body part and identify it and then state to which animal/animal group it belongs to; o be able to identify individual components of the skeletal system and discuss bone development; o be able to apply the acquired knowledge to concrete cases. o be able to work in team o demonstrate capacity to be critical and self-critical.
3	Prerequisites and learning activities	The student must know the basic notions of Cell Biology, Histology and Developmental Biology, moreover he must know the basic notion of Anthropology.
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books -K. V. KARDONG. " *Vertebrati: anatomia comparata, funzione, evoluzione*" Ed. McGraw-Hill -K. F. LIEM, W.E. Bemis, W.F. Walzer, L. Grande "Anatomia *comparata dei Vertebrati : una visione funzionale ed evolutiva"*EdiSES -G. Biondi & O. Rickards, *Umani da sei milioni di anni*, Carocci Editore, Roma.
5	Assessment methods and criteria	Written and oral exam; written text exam

Programme of "MICROBIOLOGIA GENERALE": "*GENERAL MICROBIOLOGY*"		
F0108, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES; 2nd Year ; 2nd Semester**		
Number of ECTS credits: 9 (work load is 225 hours; 1 credit=25 hours)		
Teacher: Aldo LEPIDI		
1	Course objectives	The objectives of the course are to provide the students with the basic knowledge about the place of microbes among the living beings, in the history of human civilization and in the foreseeable future of modern societies.

		Biological properties of microbes are presented as the prerequisite for their role as the very large majority of the living matter, their control of energy and mass balances in the biosphere, their irreplaceable contributions in order to have a Earth livable for man, their contribution to the production of goods and services for humans. The course illustrates the contribution of microbes to the scientific and technological progress.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the course include: - role of microbes in development of modern science and in the successes of biotechnologies; - cytology, physiology, genetics of prokaryotes; bacterial metabolisms and their regulation; - microbial growth, its regulation and continuous culture; - the boundaries of the microbial world from prions, to viruses, to prokaryotes to moulds and protozoa; - viruses and their biology/ protozoa and their biology - microbes in the origin of life and in the evolution of both living beings and Earth surface (atmosphere, soil, clean waters…); - interrelationships of bacteria with plants and animals including the human microbiome; - microbes pathogenic for man, with attention to zoonoses; - some study cases of microbial biotechnologies (agro-industry, environment, energy, food, pharmaceuticals ...) Expected Learning Outcomes are: o knowledge and understanding of the role of microbes in the biosphere, in the framework of the uniqueness of the living world; o overcoming current bases on microbes and be able to consider the microbial world structurally beneficial and only occasionally dangerous to man; o capability to identify a microbiological event and to develop a strategy for its understanding and use for human benefit; o be ready for further studies on the applied fields of microbiology.
3	Prerequisites and learning activities	Students are expected to be familiar with basic physics, cytology, chemistry and biochemistry
4	Teaching methods and language	Lectures and some laboratory training. Language: Italian and English Ref.Text books: Dehò G. e Galli E. (ed), "*Biologia dei microrganismi*", Casa Editrice Ambrosiana 2012 (più prossimo al contesto culturale italiano) Schaechter M., Ingraham J.L. e Neidhardt F.C., "*Microbiologia*", Zanichelli 2006 Perry J.J., Staley J.T., Lory S., " *Microbiologia",* 1° e 2° volume Zanichelli Madigan M.T., Martingo J.M., Parker J. BROCK, "*Biologia dei Microrganismi",* 1° e 2° volume Editrice Ambrosiana Prescott L.M., Harley J.P. , "*Microbiologia"*, McGraw-Hill 2006 Maresca B., Castellano S., Fortino V., Morello S. e Porta A., " *Microbiologia molecolare e cellulare"*, McGraw-Hill 2013
5	Assessment methods and criteria	Oral examination

Programme of "ECOLOGIA": ***"ECOLOGY"***
F0082, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 3rd Year, 1st Semester**
Number of ECTS credits: 9 (workload is 225 hours; 1 credit = 25 hours)
Teacher: Bruno CICOLANI

1	Course objectives	This course will provide an overview of ecology, the study of the interactions among organisms and between organisms and their environment. One of the central goals of this science is to identify, describe, and explain the processes that determine the distribution and abundance of organisms in nature. We will survey this discipline across multiple levels of organization: the individual organism, the population, the community, and the ecosystem. Throughout the course, we will emphasize the central role of natural selection and evolutionary thinking in the study of ecology.. The course will also explore how ecological principles can be applied to environmental problems and conservation challenges.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: *Part I* Basic ecological principles and concepts, The scope of ecology; Principles and concepts pertaining to the ecosystem and biogeochemical cycles; Principles and concepts pertaining to energy in ecological systems; Principles pertaining to limiting factors; Introduction to population and community ecology; Principles and concepts pertaining to organization at the species population level; Principles and concepts pertaining to organization at the interspecific population level; Principles and concepts pertaining to organization at the community level. *Part II* The habitat approach: Introduction; Freshwater ecology; Successful students in this course will be able to: o describe how organisms' interactions with their environment and other organisms give rise to patterns in their abundance and distribution , o demonstrate knowledge of the important ecological principles that operate at the levels of the individual organism, the population, the community, and the ecosystem , o appreciate how an understanding of evolutionary processes informs the study of ecology, o apply ecological principles to interpret ecological processes, o apply ecological principles to current environmental challenges and conservation concerns.
3	Prerequisites and learning activities	The student must know the basic notions of Botany and Zoology
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books: • Odum E. P. & Barrett G. W. - *Fondamenti di Ecologia*. III edizione italiana. Piccin Editore.-2007-
5	Assessment methods and criteria	Oral exam

Programme of "ISTITUZIONI DI PATOLOGIA GENERALE ED IMMUNOLOGIA" ***"BASIC PRINCIPLES OF GENERAL PATHOLOGY AND IMMUNOLOGY"***		
F0211, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 3rd Year, 1st Semester**		
Number of ECTS credits: 6 (workload is 150 hours; 1 credit=25 hours)		
Teacher: Adriano ANGELUCCI		
1	Course objectives	The objective of this course is to offer to the students the fundamental principles of pathology and immunobiological defenses existing in many forms of life, with particular attention to mammals and humans. On successful completion of this module, the student should be aware of the causes and processes of disease, of the fundamental tissue repair mechanisms and of the defense mechanisms leading to immunity from communicable diseases and from biologically interfering agents, with particular emphasis on the prevention of infections and of the most prevalent diseases like chronic-degenerative illnesses and cancer.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Definitions of normal functioning and of pathologic alterations leading to disease. - Classification of diseases. Environmental factors of disease. Physical, chemical and

		biological causes of disease. - Cellular pathology: reactive processes, adaptation, compensation, structural and functional features of pathological reactions. Inflammation and repair processes. - Chemical mediators of inflammation. Wound repairing. Fibrosis. Angiogenesis. Basic immunology and immunopathology. Vaccinations. Transplants. - Tumour pathogenesis, epidemiology, experimental and environmental carcinogenesis. Principles of tumour prevention. - Social, nutritional, biological and environmental prevention of the most prevalent diseases, acute and chronic. On successful completion of this module the student should o have extensive knowledge of pathobiology at the theoretical and experimental level; o have knowledge and understanding of the principal mechanisms of disease; o be able to explain the major issues of animal and human disease using appropriate scientific language; o demonstrate skill in critical analysis of potentially hazardous agents and procedures, o demonstrate capacity for reading and understand other texts on related topics. o demonstrate interest to health, well-being and safety; o be able to apply and transmit the fundamentals of disease prevention .
3	Prerequisites and learning activities	The student must know the basic notions of Biochemistry and Physiology
4	Teaching methods and language	Lectures. Language: Italian – Extensive use of English teaching materials (slides, original journals) translated and commented in Italian. Ref. Text books: • ROBBINS COTRAN*: Le basi patologiche delle malattie Patologia Generale*, VIII Ed.- 2010 – Elsevier, Italia. • RUBIN: *Patologia*, *Fondamenti clinicopatologici in medicina*, 2006 – CEA, Milano • Pontieri, Russo, Frati: *Patologia Generale*, tomo I, Ediz. Piccin, Padova, III ed 2008 • Stevens-Lowe / *Patologia* 2aEd./ Ediz. CEA, Milano 2001
5	Assessment methods and criteria	Computer test with randomly chosen multiple response questions (also providing revision suggestions), administered some days before the Oral exam.

Programme of "LABORATORIO DI TECNICHE CELLULARI E MOLECOLARI" ***"LABORATORY OF CELL AND MOLECULAR TECHNIQUES"***		
F0122, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 3rd Year, 1st Semester**		
Number of ECTS credits: 2 (workload is 50 hours; 1 credit = 25 hours)		
Teachers: Renato RODRIGUES POUSADA and Claudia ERCOLE		
1	Course objectives	The goal of this course is to provide students with their first interaction with practical aspects of working in a biological laboratory applying both basic molecular and microbiological techniques. The students at the successful end of this course should understand the principles behind the techniques demonstrated as well as know how to use some of the typical instrumentation used in biological laboratories.
2	Course content and Learning outcomes (Dublin descriptors)	The topics of this module include: - Making biological relevant solutions like buffers; the importance of pH in biology; - Spectrophotometric measurements in the UV/VIS for measuring quality and quantity of biologically isolated relevant substances and the use of spectrophotometers; - the use of necessary laboratory instruments like micropipettes, graduated pipettes, pipette aids, stirrers etc; - the principles of microbiological analysis; preparing relevant nutrient media necessary; concept of sterility; isolation of culturable heterotrophic bacteria from soil; Gram staining procedures. On successful completion of this module, the student should o have knowledge and understanding of common techniques in molecular biology and microbiology laboratories; o Be able to use instruments to measure pH and the relevancy of buffers and apply the

		principles of sterility; o Know and understand the basic principles of spectrophotometry and the instrument necessary for measuring substances spectrum (spectrophotometer); o understand different bacterial growth nutrient media and have capacity to measure bacterial contents in a microbiological culture and microscopic observation of bacteria; o be able to explain all the relevant aspects of the basic techniques used during the course; o demonstrate skill in preparing buffers solutions, nutrient media, use of a pH meter, and spectrophotometer and ability to read a spectrum of a biological extract, make serial dilutions of bacterial cultures to calculate colony forming units; o Be able to work in a group and communicate with colleagues the relevant information necessary for the common understanding of the laboratory protocols used.
3	Prerequisites and learning activities	The student must have acquired all the 1st year basic courses and have acquired Biochemistry and Genetics
4	Teaching methods and language	Lectures and laboratory team work. Language: Italian Ref. Text Books: -Teacher's lectures available
5	Assessment methods and criteria	Multiple choice written exam

Programme of "FISIOLOGIA GENERALE" ***"GENERAL PHYSIOLOGY"***		
F0059, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 3th Year, 2nd Semester**		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit = 25 hours)		
Teacher: Tiziana M. FLORIO		
1	Course objectives	The goal of this course is to provide the student with the fundamentals in functioning of the major physiological organ systems: cardiovascular, respiratory, renal, neural and gastrointestinal; as well as basic concepts of general physiology.
. 2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: General Physiology: Function and regulation of the human body fluids, composition of body fluids, membrane trasports. Omeostasis and physiological integration of the organ systems to maintain homeostasis Cellular Physiology: Discussion of cellular functions including regulatory mechanisms involving receptors and second messengers, coordination of cellular metabolism to meet physiological challenges, functional properties of membranes and the structure-function relationship of such specialized cells as muscle, vascular and phagocytic cells Cellular Neurophysiology: The fundamental mechanisms of action potential propagation, synaptic transmission, and receptor potential generation Sensory Physiology and Efferent Peripheral Nervous System: The general properties of sensory systems. The somatic senses. Muscles and Body Movement: The macro and microscopic structure of muscle. The events involved with muscle contraction and relaxation in response to an action potential. the three levels of nervous control of the movement: the spinal cord, the brain stem, the cerebral cortex Cardiovascular Physiology: cardiac performance, and the cellular, ultrastructural and molecular bases of normal cardiac function and myocardial blood flow. Different regional circulations. Neuronal, humoral and local mechanisms of regulation of organ blood flow. Mechanisms of regulation of vascular smooth muscle contractility. Influence of the endothelium on vascular tone and reactivity on local blood flow regulation. Renal Physiology: Control of the volume and composition of body fluids attributed to kidney functions. Control of glomerular filtration; nephron function; transport of fluid, electrolytes and organic molecules; endocrine regulation of the kidney. Pulmonary Physiology: Functioning of the pulmonary system in physiological conditions through the understanding of the gas laws within the body. The process of ventilation and gas exchange in the lungs. Volumes and pulmonary capacities. Gases transportation. Ventilation and its control On successful completion of this module, the student should

		- have knowledge of the essential concepts of physiology and mechanisms of body function at various levels of organization, ranging from cellular and molecular to tissue and organ system levels. - understand the integrated regulation of various body processes among the body organ, - understand the means by which the various organ systems of the human body operate and how these functions are integrated - demonstrate skill in analyzing the effects of environmental variability of the organ systems of the human body, - demonstrate capacity to apply the compiled information to clinical or research situations.
3	Prerequisites and learning activities	Physiological processes are dynamic processes that aim at preserving a constant physical and chemical internal environment. The student must have the basic physical notions and methods as acquired in the specific academic course
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books • *Fisiologia umana - Un approccio integrato* – D. U. Silverthorn. Pearson Education Italia. 2013 • *Fisiologia Generale e Umana*. R. Roades – R. Planzer. Piccin-Nuova Libraria. 2004
5	Assessment methods and criteria	Written exam

Programme of "BIOLOGIA MOLECOLARE" "*MOLECULAR BIOLOGY*"		
F0119, Compulsory 1st Cycle Degree in BIOLOGICAL SCIENCES, 3rd Year, 2nd Semester		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit=25 hours)		
Teacher: Rodolfo IPPOLITI		
1	Course objectives	The goal of this course is to provide the students with the molecular basis of cellular processes such as DNA replication, RNA transcription, protein translation. On successful completion of this module, the student should be familiar with the above mentioned processes at the molecular level, with particular attention to the mechanisms regulating each process and understanding the differences between prokaryotic and eukaryotic cells.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Structural basis of the biological molecules, including aminoacids, proteins, nucleotides, nucleic acids. - Chemical reactions involved in the formation of biological processes. - Replication of nucleic acids. - Transcription of mRNA and regulation mechanisms. - The basis of genetic code. - Protein synthesis. - Molecular biology techniques and tools, including restriction enzymes, gel electrophoresis, protein purification and analysis, northern, southern and western blotting, hybridization. Throughout the course the students will be directed to the study of the crucial and historical experiments of molecular biology On successful completion of this module the student should o have profound knowledge of the molecular basis of DNA replication, transcription, translation; o have knowledge and understanding of the principal molecules (proteins, nucleic acids, enzymes) involved in cell replication and maintenance of the genome ; o be able to explain the mechanisms of molecular reactions using appropriate scientific language; o demonstrate skill in understanding the molecular basis of nucleic acids and their processes and ability to describe the role of each molecular component in the specific process in which it is involved, o demonstrate capacity in explaining the most significant scientific experiments that deal with the molecular basis of cell life, also reading original scientific articles. o be able to apply the acquired knowledge to expand his/her scientific formation to the most advanced applications of molecular biology (gene cloning, gene therapy, molecular

		diagnostics, etc); o demonstrate concern to health, well-being and safety; o be able to work in team showing commitment to tasks and responsibilities; o demonstrate capacity to be critical and self-critical .
3	Prerequisites and learning activities	The student must know the basic notion of Chemistry, Organic Chemistry, Biochemistry
4	Teaching methods and language	Lectures. Language: Italian (available to be done in English) Ref. Text books • J. Watson et al. *"Biologia molecolare del gene"* Zanichelli editore (http://online.universita.zanichelli.it/watson-6e/) • Bonaccorsi di Patti M.C., Contestabile R. e Di Salvo M.L *"Metodologie Biochimiche",* Casa Editrice Ambrosiana, (http://www.ceaedizioni.it/ita/index.asp).
5	Assessment methods and criteria	Oral exam + written pre-exam on molecular structures

Programme of "LABORATORIO DI TECNICHE CELLULARI E MOLECOLARI APPLICATE" *"APPLIED CELLULAR AND MOLECULAR METHODS"*		
F0172, Compulsory 1st Cycle Degree in BIOLOGICAL SCIENCES, 3th Year, 2nd Semester		
Number of ECTS credits: 2 (workload is 50 hours; 1 credit = 25 hours)		
Teachers: Adriano ANGELUCCI, Paola CACCHIO		
1	Course objectives	1. to complement the theoretical studies on the eukaryotic and prokaryotic cells with lab experiences; 2. to acquire critical skill in planning and performing experiments with eukaryotic and prokaryotic cell cultures; 3. to understand the relevance of micro-organisms to the national economy and to our quality life; in particular, to acquire knowledge of the interest in bacterially promoted calcium carbonate precipitation not only in the carbon cycle but also for a variety of applications ranging from bioremediation to cementation of rocks, solid-phase capture of inorganic contaminants, and restoration of carbonate monuments; 4. to perform microbiology lab experience aimed to study bacterial calcifying strains isolated from natural habitats (soil) and their ability to precipitate *in vitro* calcium carbonate crystals.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the modules include: This course consists of two modules, each consisting of a different practical experience preceded by a lecture. MODULE OF PHYSIOPATHOLOGY (Adriano Angelucci): eukaryotic cell cultures, basic concepts: primary cultures and cell lines, cancer and transformed cell lines, *in vitro* growth requirements (nutrients, pH, temperature, adhesive properties), number of replications, confluence and growth passages. Tools and methodologies needed to maintain sterile conditions. Cell counts with count chambers. Phase-contrast microscope. Cell viability test with trypan blue. Adhesion assay on physiological substrates. Staining with crystal violet. Semiquantitative analysis by spectrophotometry. MODULE OF APPLIED MICROBIOLOGY (Paola Cacchio): Microbiology continues to evolve in intellectually exciting and practically important ways; nevertheless, it remains ultimately dependent on our ability to see microbes and to obtain pure cultures of specific ones. Practical experience of this module includes: sampling methods; inoculation methods both in liquid and in agarized media; characterization of a microbial culture especially in regard to shape and structure of colonies growth in agarized medium (a chart is provided to the student for recording appearance of colonies and assisting in understanding the appropriate terms); pure culture techniques requiring culture tranfer and three-way streak plating techniques; examples of procedures for biochemical characterization, maintenance and preservation of bacterial pure cultures; optical microscopy techniques (viewing with the immersion objective). On successful completion of these modules the student should: o have profound knowledge of eukaryotic and prokaryotic culture techniques; o demonstrate capacity for reading and understand experimental protocols; o be able to explain the relevant techniques in cell cultures using appropriate scientific language;

		o demonstrate skill in critical evaluation of results from biological tests; o be able to work in team showing commitment to tasks and responsibilities; o be critical and self critical; o be able to apply knowledge in practical situations.
3	Prerequisites and learning activities	The student must know the basic notions of General Microbiology and Physiopathology including basic concepts of prokaryotic and eukaryotic cell cultures; theory and practice of preparation of solutions; use of volumetric measuring instruments; cellular and tissue staining methods; colorimetric analysis in spectrophotometry; routine methods for media preparation and bacterial growth, serial dilution-agar plating procedure.
4	Teaching methods and language	Lectures and practical exercises in the laboratory. Language: Italian. Ref. Text Book: Teachers' Notes
5	Assessment methods and criteria	Oral exam (Physiophathology); Written exam (Applied Microbiology).

Programme of "FISIOLOGIA VEGETALE": ***PLANT PHYSIOLOGY***		
F0125, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES; 3rd Year ; 2nd Semester**		
Number of ECTS credits: 9 (workload is 225 hours; 1 credit = 25 hours)		
Teacher: Laura SPANO'		
1	Course objectives	To provide basic knowledge about morphological, biochemical and molecular mechanisms supporting plant growth, development and environmental adaptation, mainly concerned with land plants.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - Plant nutrition: water absorption and movement; mineral nutrition; metabolism of nitrogen, sulfur and phosphorus. - Energy conversion in plants; photosynthesis and respiration; lipid metabolism. - Secondary metabolism: terpenes, alcaloids and phenolic compounds. - Plant development and growth regulation: photomorphogenesis, circadian rhythms and photoperiodism. - Non photosynthetic plant photoreceptors: phytochromes, cryptochromes and phototropins. - Plant hormones: auxins, gibberellins, cytokinins, abscissic acid, ethylene, brassinosteroids and other growth regulators. Short mention to plant eco-physiolgy On successful completion of this module, the student should o have profound knowledge of biochemical and molecular mechanisms underlying plant functions, o have knowledge and understanding of the energy flux in biological systems, o understand and explain the role of plants in the environment, o understand specific scientific terms related with plant physiology, o demonstrate skill in analytical study and ability to synthesize concepts, o demonstrate capacity for reading and understand other texts on related topics. o be able to apply the acquired knowledge in the context of a general biological culture.
3	Prerequisites and learning activities	The student must have basic notions of Botany (plant anatomy and histology) and Biochemistry (metabolic fluxes, reaction kinetics, feedback regulation, structure-function relationship)
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books • Taiz e Zeiger, "*Fisiologia Vegetale",* 4 ed. PICCIN • Buchanan et al., "*Biochimica e Biologia Molecolare delle Piante",* ed. ZANICHELLI • Chrispeels Sadava, "*Genetica, Biotecnologie e Agricoltura Sostenibile",* ed.IDELSON-GNOCCHI • Alberts et al, "*Biologia della Cellula e Molecolare",* ed. ZANICHELLI
5	Assessment methods and criteria	oral exam

Programme of "FARMACOLOGIA E TOSSICOLOGIA GENERALE": *"GENERAL PHARMACOLOGY AND TOXICOLOGY"*		
F0171, Compulsory **1st Cycle Degree in BIOLOGICAL SCIENCES, 3rd Year, 2nd Semester**		
Number of ECTS credits: 6 (workload is 150 hours; 1 credit = 30 hours)		
Teacher: Anna Rita VOLPE		
1	Course objectives	This course aims to provide the students with an integrated scientific background able to face the complex sectors and problems characterizing the pharmaco-toxicological field. Experimental, pharmaceutical, biological, clinical and environmental aspects concerning drugs and toxic compounds are examined to allow the students to obtain adequate and up-dated competences in Pharmacology and Toxicology to be applied to their various professional activities.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: General principles, definitions, classifications, branches of Pharmacology and Toxicology, origin and nature of drugs and toxins, routes of administration. Elements of Pharmaceutical Biology, Pharmacological Biotechnologies and Veterinary Pharmacology. Absorption, distribution, elimination and biotransformations of xenobiotics. Pharmacokinetics and toxicokinetics: mechanisms of action, receptors, molecular bases, dose-effect and structure-activity relationships, gradual and quantal responses, analysis (topographic, chronologic, dynamic) of the pharmacological and toxicological effects, biologic dosage. Evaluation of the toxicological risk. Drug interactions. Changed responses to xenobiotics: allergy, tolerance, resistance, dependence, teratogenesis, mutagenesis, genotoxicity, cancerogenesis, etc.- Toxic-induced apoptosis, necrosis and necroptosis. *In vivo, in vitro, ex vivo* models and technologies for the study and monitoring of xenobiotics. Planning, development, production and testing of new drugs; ethics and regulations. Classes of drugs for therapeutical employment in humans with special attention to those concerning the autonomous nervous system as well as the cardiovascular, autacoidal, hemopoietic and endocrine ones. Gene therapy and biotechnological drugs. Classes of toxins with special attention to metals, pesticides, animal and vegetal toxins, bacterial and fungal toxins, micotoxins and chemical cancerogens. Regulations in Toxicology. Prevention and treatment of intoxications. On successful completion of this module, the student should o have profound knowledge of the biological bases of Pharmacology and Toxicology. o have knowledge and understanding of the effects and mechanisms of actions of drugs and toxins as biological regulators or disruptors. o understand and explain the employment of drugs in pathological conditions. o understand the pathogenetic role of environmental and occupational toxins. o demonstrate skill in evaluating physiopathological conditions and ability to suggest pertinent pharmacological approaches. o demonstrate capacity in integrating different basic biological competences to understand actions and effects of drugs and toxins. o apply the acquired knowledge to concrete cases as occurring in the professional life. o demonstrate concern to health, well-being and safety. o have ability to search for, process and analyse information from a variety of sources.
3	Prerequisites and learning activities	The student must have adequate knowledge of Organic Chemistry, Biochemistry and Physiology.
4	Teaching methods and language	Lectures. Language: Italian Ref. Text books • B.G. Katzung, *Farmacologia generale e clinica*, Piccin, Padova (last edition). • C.L. Galli, E. Corsini, M. Marinovich, *Tossicologia*, Piccin, Padova, 2004. • H. Greim, E. Deml., *Tossicologia*, Zanichelli, Bologna, 2000. • *Goodman & Gilman's the Pharmacological Basis of Therapeutics*. McGraw-Hill, New York (last edition). • C.D. Klaassen (Ed.). Casarett & Doull's, *Toxicology*, McGraw-Hill, New York (last edition) • L. Annunziato, G. Di Renzo (Eds.), *Trattato di Farmacologia*, vol. I-II. Idelson-Gnocchi, Napoli (last edition).
5	Assessment methods and criteria	Oral exam

Programme of "ABILITA' INFORMATICHE E TELEMATICHE" "*LABORATORY OF INFORMATICS*"		
F1149, OPTIONAL **1st Cycle Degree in BIOLOGICAL SCIENCES, 2nd Year, 1st and 2nd Semester**		
Number of ECTS credits: 4 (workload is 100 hours; 1 credit=25 hours)		
Teacher: LIBERO PALLADINO		
1	Course objectives	The objectives of the course are a) introduction of the measurement process and the relative statistical analysis and b) introduction of the use of computers in the analysis of experimental data.
2	Course content and Learning outcomes (Dublin descriptors)	Topics of the module include: - What does make a measurement? - Features of an instrument and calibration of an instrument. - Differences and comparisons between analog and digital measurement. - Absolute and relative errors. Statistical analysis of the data. - Significant figures and the relationship between the measure and its error. - Law of Gauss distribution: representation and characteristics. - Indirect measures: measures of magnitudes obtained from measurements of direct linked by a report / mathematical function. - Using a computer code for data analysis (statistical analysis and least squares method applied to a straight line) On successful completion of this module the student should o have profound knowledge data analysis; o have knowledge and understanding of use of the statistical methods; o be able to explain the relevant topics and methods using appropriate scientific o language; o demonstrate skill in laboratory ability and capacity in the use of instrumentations and execution of a laboratory experience. o be able to apply the acquired knowledge to concrete cases as occurring in the professional life; o demonstrate concern to health, well-being and safety; o be able to work in team showing commitment to tasks and responsibilities o demonstrate capacity to be critical and self-critical
3	Prerequisites and learning activities	The student must know the basic of Arithmetic, Algebra, geometry and mathematical analysis
4	Teaching methods and language	Lectures and Laboratory experiences. Language: Italian Ref. Text books -Taylor. *Introduzione all'analisi degli errori* - Zanichelli. -Bevington, P. et al., *Data Reduction and Error Analysis for the Physical Sciences* , McGraw-Hill, 2002 -Memos and notes
5	Assessment methods and criteria	Written and Oral exam