	Type*	Name of the unit	ects	H Course	H tutorial works	H practical lab works	Topics
Semester 1	C	**Chemistry applied to Life Sciences**	**5 ects**	**39**		**12**	
			1: Pure Products, states of matter, mixture. 2: Quantities characterizing a chemical system. 3: material balance of chemical reactions. 4: Fundamentals of Energy. 5: Energy of the chemical reaction. 6: Chemical equilibrium. 7 Essentials acid-base aqueous solution. 8: Determination of the pH and the composition of aqueous acid-base solutions. 9: Examples of acid-base systems of biological interest. 10 Essentials redox in aqueous solution. 11: Potential and electrochemical cell. Practical lessons illustrate the course through 5 sessions involving titration manipulations by colorimetry, pH measurement and potentiometric Teaching methods (use numeric platform, supporting the student's personal work).				
	C	**Animal Biology 1**	**5 ects**	**41**		**19 (Bil)**	Animal body organization : Spongiaria, Cnidaria, Platelminthes, Annelids, Mollusc, Arthropodes, Echinoderms, Urochords, Cephalocords, Vertebrates
	C	**Cell Biology 1**	**5 ects**	**30**	**10 (Bil)**	**12 (Bil)**	
			Courses: Cell Concept: the use of the microscope and the discovery of the existence of cell to cell and modern molecular biology. Different cell types and structures: prokaryotic and eukaryotic, animal and plant cells. Concept of virus. essential biological molecules. plasma membrane and internal membranes. Endocytosis and exocytosis. Endoplasmic reticulum, Golgi apparatus, the cytosol, vacuole. Core and ultra-structure of chromatin. Energy Conversion organelles: mitochondria and chloroplasts. – *Directed works*: light and electron microscopy techniques. The cell and its organization. cell fractionation. The use of radioactive precursors in cell biology. Plant cell: vacuole wall and plastid. *Practical works*: use the light microscope. Observation of animal and plant cells. Microscopic study of mitosis. Cytochemistry.				
	C	**Organic Chemistry 1**	**5 ects**	**20**	**20**	**8 (Bil)**	Items and main functional groups. - The link in organic chemistry (carbon hybridizations). - Electronic effects in organic chemistry (induced effects and mesomeric). - Acids and bases; electrophilic and nucleophilic. - Representations of molecules (notions of isomerism and stereoisomerism). - Reactions of nucleophilic substitution reactions and eliminations (eg halogenated derivatives). - Reactions of electrophilic additions (eg alkene and alkyne).
	C	**Mathematics applied to life sciences**	**4 ects**	**40**	Limits, Derivative, differential equations of first and second order, Primitives function to a variable, Riemann integrals of functions to a variable, Partial derivatives, Differential, Gradient, Local Extrema, uncertainties calculations.		
	C	**Physics applied to life sciences**	**4 ects**	**12**	**24**	**12 (Bil)**	Two areas selected: fluid mechanics (application to hydrology and blood circulation) and geometrical optics (functioning of

							the eye study of binocular microscope and the optical microscope).
	C	**Transversal Unit : Personnal Professional Project**	**2 ects**	**20**			
	O	**Bilingual groups (Bil)**	Selected students in the bilingual groups, will follow tutorial and practical lab courses in scientific english, both oral, written and exams.				
Semester 2	**C**	**Plant Biology 1**	**5 ects**	**30**	**10 (Bil)**	**10 (Bil)**	The major morphological and anatomical characteristics of the Fungi, Algae and Embryophytes (Moss, ferns, gymnosperms and angiosperms) will be studied using examples. They will be addressed in an evolutionary angle (vegetative and reproductive apparatus). Physiology of elements necessary for understanding the adaptation to their environment will be made. The main food and non-food uses will be specified for each group.
	C	**Biochemistry 1 : Life molecules**	**5 ects**	**30**	**10(Bil)**	**8(Bil)**	
			Structural Biochemistry: - Carbohydrates: monosaccharides (nomenclature and representations of aldoses and ketoses, neutral sugars, amino sugars and acid saccharides), main properties (optical rotation, redox, methylation), glycoside bond, oligosaccharides (maltose, lactose, sucrose, raffinose), polysaccharides (homo-polysaccharides such as starch, glycogen, cellulose, and examples having biodiversity hetero polysaccharides). - Proteins: amino acids, peptide bond and some peptides of biological interest (glutathione, hormones), proteins (primary, secondary and tertiary structures with examples of fibrous proteins and globular quaternary structure illustrated with hemoglobin) and definition hetero-proteins. -The Lipids: structure of saturated and unsaturated fatty acids, chemical properties (micelles, saponification, iodine, oxidation fixation), definition of families of simple and complex lipids (glycerides, glycerides, sterides, glycerophospholipids, sphingolipids and glyceroglycolipids). -The Nucleic acids: nitrogenous bases, nucleosides, nucleotides and nucleic acids (DNA and RNA, base pairing). Introduction to enzymology: The classification of enzymes, their main properties (specificity and concept of bio-catalysts) and the definitions of Km and Vm will be addressed. metabolic biochemistry: - Cellular Bioenergetics: ATP and its regeneration, the Krebs cycle, the respiratory chain and mitochondrial ATP synthase. -Origine Glucose catabolism (glycolysis, decarboxylation of pyruvate, ethanol fermentation and lactic). -Catabolisme Fatty acids (Lynen helix). The course will be complemented by tutorial works, for the part structural biochemistry and enzymology, particularly through application exercises, and 2 sessions of practical lab courses, experimental discovery of structural biochemistry.				
	C	**Genetics 1 : formal and molecular genetics**	**5 ects**	**32**	**18 (Bil)**		
			1) Mendelian Genetics: Definitions of continuous and discontinuous characters. Role of the environment in achieving. Importance of quantitative genetics in plant breeding. Defining first and second laws of Mendel. Introduction to polyhybridisme. Advanced Mendelian genetics: allelic series of concepts and intermediate				

			dominance applied to blood groups, lethality, pleiotropic effects. Analysis of pedigrees and human genetics. 2) The chromosomal theory of heredity: Confrontation of the theory of Sutton and Boveri to the cytological description of mitosis and meiosis. Relationship of the mitotic cycle of cell division cycle. Description of gametogenesis and meiosis. Setting the brewing chromosomal and inter-chromosomal recombination. chromosome theory and gender link. Discover the intra-chromosomal recombination Morgan. Introduction to gene mapping. mapping function. 3) The gene-enzyme relationship: The life cycles of the most important eukaryotic microorganisms by genetic (*Saccharomyces, Neurospora*). Analysis of ordered and disordered tetrads. The relationship enzyme gene. Notions epistasis recessive and dominant. 4) Structure of nucleic acids, gene and central dogma of molecular biology: Definition of nucleic acids as a carrier of genetic information. Structure of nucleic acids and the central dogma of molecular biology. 5) Origin of allelic diversity and genetic diseases gene mutations, chromosomal and genomic. Mobile genetic elements causing chromosomal mutations. Main genetic diseases in humans. 6) Structure and function of the gene: application of biochemical genetics. 7) Tutorial of Formal Genetics: Exercises illustration of notions underway.				
2 options among 3	**0**	**From atom to the complex molecule**	**5 ects**	**48**	**3**		
			Part 1. Atomistic, Nucleus, atom, element constitution and propertie Interactions between electromagnetic waves and matter. wave-particle duality electronic structure of the atom in the quantum model periodic table of elements and atomic properties **Part 2.** Chemical bonding covalent bond in the Lewis model covalent bond: geometric parameters, energy and electricity covalent bond in the quantum model van der Waals interactions and hydrogen bonding The skills are taught using the following tutorial documents: Nucleus, atom, element constitution and properties (Chapter 1) Interactions between electromagnetic waves and matter (Chapter 2) Wave-particle duality (Chapter 2) electronic structure of the atom in the quantum model (Chapter 3) Structure of the periodic table (Chapter 4) Evolution of atomic properties in the periodic table (Chapter 4) Determination of atomic properties using the Slater model (Chapter 4) covalent bond in the Lewis model (Chapter 5) VSEPR theory - Rules Gillespie (Chapter 5) Determination of the oxidation number of an atom from a Lewis structure (Chapter 5) covalent bond: geometric parameters, energy and electricity (Chapter 6) covalent bond in the quantum model (Chapter 7) van der Waals interactions and hydrogen bonding (Chapter 8)				
	0	**From the cell to the organism in its ecosystem**	**5 ects**	**30**	**16 (Bil)**	**4 (Bil)**	
			1-Introduction (what is a living organism, unicellular and multicellular multicellular, trophism) 2- Communications within the organization (Animal: cell junctions, blood and lymph, external and internal environment, Vegetal: plasmodesmata, phloem, traffic information) 3-The increasing complexity of organizations (why move from unicellular to multicellular animal histology) 4-Introduction to ecology (definition, history of science) 5- Animal Interactions, plant and within an ecosystem The 6-trophic relationships (flows of energy, biomass, food chains) 7-distribution of abiotic factors, and notions of habitat 8- Dynamics of ecosystems and biomes concept				

			9-The impacts of man on ecosystems				
	O	**Main animal physiological functions**	**5 ects**	**32**	**14 (Bil)**	**6 (Bil)**	Breathing, Digestion, Sexual reproduction
	C	**Transversal Unit : Personnal Professional Project 2**	**2 ects**	**20**			
	O	**Bilingual groups (Bil)**	Selected students in the bilingual groups, will follow tutorial and practical lab courses in scientific english, both oral, written and exams.				
Semester 3	**C**	**Microbiology 1**	**5 ects**	**33**	**14**		
			A-Bacteria Historics. The bacteria: size and organization; variety of envelope the three domains of life. Taxonomy and phylogeny of bacteria. The metabolism of bacteria and specific metabolic pathways of some bacteria: anaerobic respiration, fermentation, methanogenesis (Archaea), sulfate reduction. Relations bacteria among themselves and with other agencies: the biofilms. bacterial associations: the intestinal flora, dental plaque. The use of bacteria by man: the food, detoxification **B-** celled eukaryotes and parasites, viruses Yeast and filamentous fungi. The endosymbiosis unicellular eukaryotes. Virology: history, definitions, structures, methods, classification. Viruses infect animal cells. Bacteriophages. Viroids and prions				
	C	**Biostatistics 1**	**5 ects**	**21**	**18 (Bil)**	**8 (Bil)**	
			- Graphical Information Processing - Basic Distributions (Normal, Binomial, Poisson) - Parameters of a Distribution - Hypothesis test and Chi-square				
3 options among 6	**O**	**Plant Physiology 1**	**5 ects**	**24**	**4 (Bil)**	**19 (Bil)**	Nutrition, Photosynthesis, Growth, Plasmolysis, Turgescence
			The skills acquired are both theoretical and experimental. At the end of this module, students will have acquired basic knowledge of the general operation of the plants. The student will also be able to conduct experimental work, will reflect critically on this work and write a summary of the results. The EU regards students wishing prepare a master to prepare a career researchers or teacher-researchers, public or private, in the plant science industry and agricultural research, as well as students wishing to make an engineering school. This module is also required for students wishing to move towards the preparation of the Capes or aggregation. In this teaching, will presented: * concepts for understanding the movement of water in the plant and between the plant and its environment (physical and chemical properties of water, concept soil-plant-atmosphere physical mechanisms of movement of water and water potential) * methods of study of the mineral nutrition, the concept of macro and microelements, essential element, the absorption of minerals from the ground and transport in the plant, * the transformation of light energy into chemical energy, * the photosynthetic cycle of carbon reduction, photorespiration and the cycle photosynthetic carbon oxidation, studies of photosynthetic type C3, C4 and CAM, * nitrogen nutrition and symbiotic nitrogen fixation * the concept of hormones (growth factors?) in plants, * the response of plants to environmental factors				

			(light, photoperiod, temperature)				
	O	**General Ecology**	**5 ects**	**32**	**16 (Bil)**		
			Ecology is centrally located in Biology because it is placed at the interface many disciplines of this area. Several topics of this discipline will be presented to the student gets a global view and different perspectives on this matter. * Introduction (History and emergence of the concept of ecosystem; 4 levels hierarchical ecology; the parameters which act on the individual; example of a case studies in ecology at various scales of observation) * Evolutionary Ecology (Science of Evolution, biotic interactions; Ethology) * Functional Ecology (Operation of the Biosphere; Microbial Ecology) * anthropogenic impacts (human Pollution and its effects; Human & Biodiversity)				
	O	**Animal Embryology**	**5 ects**		**36 (Bil)**	**12 (Bil)**	Cnidaria, Reptile, Bird, Mammals, Human models
			Describe the fundamentals of the embryo, its territories, the stages of its development, they are common to models or specific during evolution. Integrate associated cell biology concepts. Set experimental approaches to understanding the origin of the large development. Use the search tools and databases didacticielles preparing sessions practices and getting them to respond to continuous control issues or revise lessons. Content description: Courses and tutorial works : After short reminders Gametogenesis on bets prefiguring the seats early stages of development from the oocyte, the respective contributions of the sea urchin models amphibians, birds, and mammals for the understanding of the great phenomena of early development will be studied based on experimental methods studied that allowed the interpretation. The integration of this knowledge in the context of prior cell biology, animal biology and physiology will be privileged. Practical Lab works: practical work on the living will be conducted in workshop sessions. Study of gametogenesis and fertilization (amphibians), followed by segmentation (amphibians) and deleterious effects of certain molecules on these processes. Development of the chick and mouse (especially with study placentation).				
	O	**Animal Cell Physiology**	**5 ects**	**28**	**14 (Bil)**	**6 (Bil)**	
			The aims of this unit isto acquire the knowledge of the parameters governing the cellular excitability, coding and conduction of nervous information and the mechanisms of the transduction phenomenon electrical into mechanical force.. Cell physiology is the study of physiological processes at the cell level. The Lessons covered in this module will enable students to approach concepts: * laws and mechanisms governing exchange membrane, * membrane potential, cell excitability and ion channel, * coding, conduction and transmission of nerve information, * transducing an electrical signal into a force or coupling excitation contraction. The neuron and muscle cell models are the choices that will be used to develop these different concepts.				
	O	**Biochemistry 2**	**5 ects**		**25 (Bil)**	**32 (Bil)**	
			The unit aims, in a first time, to describe and explain practices laboratory, ie the fundamental rules and basic gestures good use. Basic tools: glassware (pipettes, volumetric flasks, graduated cylinders ...), automatic pipettes, scales (for weighing precision) spectrophotometer ... Safety rules to respect will Also detailed in this first part. The second part of this course will be devoted to the identification and study of the various families of organic molecules, ie the carbohydrates, proteins, nucleic acids and lipids. The structural study will be addressed to each family and the function of some of them will also be considered by a particular introduction to enzymology and metabolism study.				

			In this part will also focus placed on the assays of various biological molecules. For practical work: * The laboratory safety (2h) * The material used in -Apparatus verrerie- and biochemistry (2h) * structural study of carbohydrates (4h) * Study of lipids -application to vegetables- oils (4h) * Methodology (4h) * Study of amino acids and proteins (4h) * structure-function relationship of a protein: invertase (8h) * Preparation of biological macromolecules and study of nucleic acids (4h) * molecular fractionation (4h)				
	O	**Organic Chemistry 2**	**5 ects**	**17**	**18**	**12**	The physical and chemical properties of these families will be studied:- Grignard reagents- Alcohols and thiols - Phenols - The carbonyl compounds (aldehydes... and ketones) -The amines The reactivity of aromatic compounds will also be considered.
	C	**Transversal Unit :**	**5 ects : 4 complusory and one to choose**	Security rules in lab (2)-C , Languages 1 (2)-C, Languages 2 (1)-O, Sport (1)-O, Association involvment (1)-O, Scientific English (1)-O			
	O	**Bilingual groups (Bil)**	Selected students in the bilingual groups, will follow tutorial and practical lab courses in scientific english, both oral, written and exams.				
Semester 4	**C**	**Cell Biology 2**	**5 ects**	**22**	**14**	**8 (Bil)**	
			Fundamental and technological knowledge will be acquired by the student on the structural organization of cell, its functioning, its dynamics, its regulation by elements waterfalls signal transduction and its interactions with other cells or cell components. The following themes will be addressed: cytoskeleton in organizing and cellular dynamics; extracellular matrix: the signal in the biological response; communication within and between cells; cell regulation by tyrosine kinase receptors; cell cycle, cell division and its regulation (paradigms: yeast and amphibian; pathologies associated with its deregulation); histological techniques.				
	C	**Cell Biochemistry**	**5 ects**	**20**	**8**	**16 (Bil)**	
			Course: Bioenergetics: ATP regeneration, coupling oxidative phosphorylation, Enzyme kinetics: michaelien enzymes, allosteric enzymes, multi-enzymatic complexes. Metabolism: glycogen metabolism, glycolysis and gluconeogenesis, fatty acid metabolism. Metabolic regulation: metabolic pathways and regulation, regulation of enzyme activities Hormonal signaling. Hormones coupled to intracellular production of AMPc, hormones coupled to production of intracellular IP3, action of insulin, action of cortisol. Tutorial and Practical lab courses: separation and analysis of biological molecules, chromatographic and electrophoretic techniques, enzyme kinetics				
	C	**Microbiology 2**	**5 ects**	**24**	**8**	**12**	
			Growth, backgrounds. The bacterium. Bacterial envelope. Biogenesis of bacterial envelope. Search of food. bacterial communication. host / bacteria: pathogenesis and symbiosis. Antimicrobial peptides. The EU affects all areas of activity where the student will be in confrontation with bacterial pathogens (for animals or plants) and / or bacterial metabolism and / or bacteria present in the environment.				

	C	**Genetics 2**	**5 ects**	**28**	**4 (Bil)**	**12 (Bil)**	
			1) An overview of the different modes of transmission of characters, namely: - Nuclear heredity characters determined by major genes, or changes structural genome (transposable elements) - Cytoplasmic inheritance to characters (mitochondrial or chloroplast genomes). 2) Formal genetics concepts and gene mapping tools to localisation and characterization of loci controlling the variation of important traits in humans, animals or plants. 3) Practical knowledge on the implementation of crossing, determination phenotype and genotype of the descendants (visual observation, use of markers genetic) and methods for collecting and interpreting results. 1) Nature and detection of DNA-polymorphism (genetic markers, sequencing); cartography and genetic characterization of loci controlling the variation in nuclear heredity characters; 2) Cytoplasmic inheritance (cytoplasmic male sterility in plants, transmitted human diseases by mitochondria, senescence mitochondria, characters transmitted by the plastid); 3) Transposable elements (moving elements corn: chromosomal rearrangements and control gene expression, transposable elements and hybrid dysgenesis in Drosophila). Tutorial and Practical Lab Works: Determination of genotype individuals in segregation for different marker loci (phenotypic, isoenzymes, genetic markers / PCR); genetic linkage studies; cytoplasmic male-sterility higher plants				
1 option among 3	**0**	**Physiology of animal Cell communication**	**4 ects**	**22**	**12 (Bil)**	**6 (Bil)**	
			The unit aims to address through selected examples in the scientific literature, modes of intra- and intercellular communication in animal systems. In this context, the different modes of communication, the major families of signaling molecules and their receptors (membrane and intracellular), the signal transduction pathways for each class of receptor (coupled to G proteins, intrinsic tyrosine kinase activity or associated intracellular receptors / transcription factors, receptor-channels) and effector signaling (cytoplasmic or nuclear proteins) will be addressed and special attention will be given to the messengers involved in the different signaling pathways.				
	O	**Plant resources valorization**	**4 ects**	**17**	**8**	**15**	
			The plant products are an important part in our diet and are used in various products of everyday life. In a global context of increasing food requirements and the introduction of products derived from vegetable in our industries, this course will address the various agricultural and industrial sectors related to crop production. The channels will be addressed by major product groups in chapters entitling produce sugar, starch produce, produce oils, produce proteins, producing gelling produce lignocellulosic biomass. Each sector will be approached from a physiological angle, agricultural and industrial (process of extraction, modification, economic context). Finally in a chapter describing biological changes of plant products (fermentation) will address the transformation of grapes into wine, wheat bread. These concepts will be pursued in tutorial works, for the preparation of an oral presentation which aims to facilitate a discussion around a die, and by handling during practical sessions (bioplastic manufacturing, extraction of proteins, secondary metabolites, and gelling agents, highlighting fermentations).				
	O	**Mathematics for engineer**	**4 ects**	**40**			
			Linear algebra: vector spaces, free families, generators, bases, linear mappings, matrices, determinant, solving linear equations, vectors.				
	C	**Transversal Units:**	**5 ects: 1**	Job profiles and missions			

		Languages 1 (1)-C	**compulsory and 4 to combine**	Association involvement Scientific English Microscopic technologies for life sciences Sport Scientific bibliographic dissertation Sexual ratio and genders Professional and personal project: Job and Internship profile, skills and missions. History and Epistemology of Life Sciences: how social, political, and cultural values affect scientific research and application, and how these affect society, politics and culture. The case of History and Epistemology of theories of natural and cultural transformation (Lamarckisms, Darwinisms).				
	O	**Bilingual groups (Bil)**	Selected students in the bilingual groups, will follow tutorial and practical lab courses in scientific english, both oral, written and exams.					
Semester 5	**C**	**Cell dynamics**	**5 ects**	**24**	**14 (Bil)**			
			- Signaling of hormones and growth factors - Cell proliferation and cell cycle control - Stem cells and cell differentiation. - Cell death by apoptosis. - Oncogenic Concepts, immortalization, transformation and oncogenesis					
	C	**Biology of Development**	**5 ects**	**21**	**12 (Bil)**	**11 (Bil)**		
			A- Establishment of embryonic axes of *Drosophila* (laboratory animal model), gene expression and control of embryonic and post-embryonic stages B- Development embryonic post, imaginal discs and insect diapause C-Metamorphosis and hormonal control D- Embryology plants, angiosperms Eudicot example of Arabidopsis (a model plant laboratory) F- Primary Plant development: establishment of the apical-basal axis, polarity, and the establishment of primary tissues, cytological characteristics, gene regulation G-Radial Plant development: cambiums activation and implementation of secondary tissues, gene regulation					
	C	**Animal and Plant Biotechnologies**	**5 ects**	**24**	**14**	**6**		
			Scientific basis of biotechnology: genetic engineering (gene cloning, sequencing, DNA amplification), genomics (molecular markers), molecular engineering, biochemistry and RNA genes regulation. Animal: gene transfer methodology via the gametes and embryonic somatic cells. Heterologous and homologous recombination. Diagnostics test. Nanobiotechnologies. Fundamental and applied aspects. Plant: plant cloning technologies, conservation of genetic structure, and establishment of new characters: somaclonal variation, mutagenesis, somatic hybridization, embryo rescue, gene transfer methodology, cloning of genes and strategies vectorology. Fundamental and applied aspects.					
	C	**Genetics 3**	**5 ects**	**26**	**18 (Bil)**			

			Description of the eukaryotic chromosome and changes in ploidy, the number or arrangement of chromosome segments. Study of the mitochondrial genome specificities of gene expression in mitochondria and mitochondrial diseases. Structural genomics databases: genetic linkage, genetic and physical maps. Historical background of technological advances that enabled genome sequencing, Introduction to virology. Population genetics basis.				
2 options among 5	**O**	**Unicellular Eukaryotic Genetics**	**4 ects**	**12**	**8**	**20**	
			The life cycles and 3 eukaryotic models of growth patterns (*Saccharomyces cerevisiae, Chlamydomonas reinhardtii* and *Neurospora crassa*); microbial phenotypes and environments selective: molecular explanations of the phenomena of dominance-recessive; test complementation and implementation, reversion mutation and deletion; technical arrangements for selection diploid and meiosis products. Introduction to biochemical genetics: usefulness of mutant selection for establishing routes Metabolic and their regulation; the case of tryptophan metabolism in S. cerevisiae; cartography nuclear gene for meiotic recombination; analysis spores random function cartography; analysis of ordered tetrads; analysis of ordered and disordered tetrads analysis tetrads applied to tetraploid. Introduction to extrachromosomal genetics: general characteristics: mitotic segregation, polar transmission and cytoduction. mitochondrial gene in S. cerevisiae: phenotype heredity small; mitochondrial and plastid gene in unicellular green algae Chlamydomonas reinhardtii				
	O	**Genetics of Bacteria**	**4 ects**	**20**	**4**	**18**	
			DNA support of heredity. The mutations in bacteria: SOS induction. Genetic exchanges in bacteria: the discovery. The different types of genetic exchanges: conjugation, bacteriophages, transduction and transformation. Genetic exchanges: role in pathogens. Bacterial genetics in practice: the example of the tryptophane operon in *E. coli*. The homologous recombination.				
	O	**Homeostasis and Regulation of physiological functions**	**4 ects**	**22**	**10**	**8**	
			Homeostasis: basic principle of homeostasis, notion of internal environment, concept of indoor control - notion of feedback. Thermoregulation as an example of homeostatic function. Cardiovascular physiology: cardiac activity cycle, vasculature and regulation, homeostatic short-term pressure and diseases. Pulmonary function: gas transport and exchange, ventilatory mechanics, chronic obstructive pulmonary disease. Renal physiology: glomerular filtration, sodium absorption, water excretion based on the control of osmolarity and blood volume, and kidney hypertension. Autonomic nervous system: structural and functional organization.				
	O	**Integrative Neurophysiology**	**4 ects**	**23**	**11**	**6**	
			Organization and functioning of the nervous system. It focuses on integrated aspects: posture and motor skills, learning and memory, biological rhythms, sleep, general operating principles of sensory systems. The tutorial works should allow students to deepen the knowledge gained with the different lectures, but also to understand and operate experimental and scientific results. The lab work is done in rats (Skinner behavioral test) and in humans (myotatic reflex). These experimental approaches are complementary to lectures and TD, and strengthen understanding of neurophysiological mechanisms.				
	O	**Plant Physiology: perception and**	**4 ects**	**20**	**10**	**10**	
			Phytohormones: characteristics and physiological effects. An example of signal transduction: the photoperception,				

		communication face to environment	photoreceptors, and the functioning of phytochrome. Coordinated responses to internal and external signals. The plant body and its regulation: dominance and tropism. Reduction and cessation of growth to prepare for the stressed season: leaf senescence, and bud dormancy				
	C	**Transversal Units: Languages 1 (2)-C**	**2 ects compulsory**				
	O	**Bilingual groups (Bil)**	Selected students in the bilingual groups will follow tutorial and practical lab courses in scientific english, both oral, written and exams. As the bilingual students choose different options, the group is teached in french. But many evaluations (oral, written reports, poster, dissertation) were performed in english (oral and written).				
	0	**Research supplement to the BSc degree**	Student can choose to undergo this 'Label'. It contains: 20h on business and companies knowledge, one month full-time internship in a research Lab, scientific report, and oral defence.				
Semester 6	**C**	**Immunology**	**4 ects**	**24**	**6**	**12**	
			The goal of this unit is to give all the bases of basic immunology for both organs and immune cells, the antibody notions, antigens, and supplements. The involvement of these elements in the anti microbial response during a first or a second infection will be discussed. The element of innate immunity will be addressed as the regulatory concepts of the immune response. Eventually, students will have acquired the basics of general and functional immunology, illustrated by specific examples. Tutorial works: immunization, evolution of the immune system. Practical lab works: ELISA, agglutination tests, blood typing.				
	C	**Experimental strategies**	**4 ects**	**14**	**16**	**12 (Bil)**	
			This unit enables to develop in students a critical analysis and perspective, based on the principles of strategies to be implemented to answer the experimental questions. It will be based on the technological limits learned during the Bachelor. The student must choose the most appropriate techniques to solve problems encountered in laboratories. Scientific issues in plant and animal experimentation are raised. The courses allow recalling the basic principles and technologies. Students therefore have to choose a strategy and comment it.				
	C	**Internship in a lab, or research project**	**5 ects**	Internship: one month full-time internship according to student project in private or public organism Project: presentation of background, elaboration of protocol and expected results for an original research project proposed by a researcher. Internship and project are evaluated by a written report and oral defence.			
	O	**Plant Physiology: Development**	**4 ects**	**21**	**10**	**9**	
			Products of plant origin are an important part of our diet whether consumed without or after processing. In a context of world population growth, an understanding of the factors regulating the establishment of organs of agronomic interest (quantity but also quality) is a prerequisite to try to find solutions. Aspects related to the integrated operation of the plant, the setting up of organs of interest, allocation of photoassimilates and reserve accumulation will be discussed.				
	O	**Plant Genomics**	**4 ects**	**24**	**16**		
			The aims are the acquisition of theoretical knowledge of the latest advances or emerging strategies in genomics research of plants, in particular in the knowledge of genome structure and regulation of their expression.				

<table>
<tr><td rowspan="7">3 options among 9</td><td></td><td></td><td colspan="5">At the end of the course, the student is able to:
- Gain theoretical knowledge in the field of plant genomics
- Justify the use of experimental strategies tailored to a given problem
- Search and synthesize information in the field of genomics</td></tr>
<tr><td>O</td><td>Plant Ecophysiology: stress and climatic changes</td><td>4 ects</td><td>18</td><td>14</td><td>12</td><td></td></tr>
<tr><td colspan="5">Search conceptual and experimental information
• Integrate and implement concepts and knowledge networks previously taught in this unit distinct throughout the course in Bachelor
• Explain, in a simple way, the origins of climate change and pollution and linkages with climate change
• Describe the consequences of abiotic stress (drought, cold, salt, UV, Ozone ...) on the physiology of a plant and / or population
• Understand and introduce various mechanisms and coping strategies used by plants
• Present examples of phytopathogens and diseases in plants</td></tr>
<tr><td>O</td><td>Sensorimotor physiology</td><td>4 ects</td><td>24</td><td>10</td><td>6</td><td></td></tr>
<tr><td colspan="5">The objectives are: to study the physiology of voluntary and automatic movement by neural, muscular, biomechanical, and metabolic aspects; to study the physiology of sensory systems (visual, auditory, gustatory, olfactory) and their different information processing levels (receptor cells, tract, central control).</td></tr>
<tr><td>O</td><td>Physiology of Nutrition</td><td>4 ects</td><td>21</td><td>12</td><td>7</td><td></td></tr>
<tr><td colspan="5">The objective of this unit is to enable students to acquire basic knowledge in experimental physiology of nutrition. The energy value of food, the physiology of digestion, food metabolism, regulation of energy metabolism and food intake will be studied. The dialogue between the peripheral tissues and the central nervous system will be discussed. Tutorial works: some pathologies associated with dysfunction of energy homeostasis will be described (Type 2-diabetes, dyslipidemia, obesity).</td></tr>
<tr><td>O</td><td>Endocrinian communication</td><td>4 ects</td><td>22</td><td>10</td><td>8</td><td></td></tr>
<tr><td colspan="5">This unit provides theoretical knowledge allowing the student to have a solid training in the molecular aspects and integrated endocrine communication. This will be studied in normal and pathological situations. The structure and mechanisms of action of the main hormones, the main modes of hormonal communications and the concept of feedback loops will be developed. The pituitary-hypothalamic complex, the real conductor of neuroendocrinology will be described. The endocrine regulation systems dependent and independent of this complex, will be studied. Finally, the new concept of communication between endocrine and immune systems will be discussed.</td></tr>
<tr><td>0</td><td>Animal Models</td><td>4 ects</td><td>18</td><td>12</td><td>10</td><td></td></tr>
<tr><td colspan="5">Reviewing of the knowledge gained in previous teaching units (immunology, cell Biology, physiology...) through the filter of experimental animal models that allowed to establish the main mechanisms. Understand the historical and institutional, legal and ethical implications of this type of experiment.
Tutorial works will enable students to deepen the knowledge gained with the various lectures, but also to understand and operate experimental and scientific results. The lab work is done in the form of training workshops for problem roundtables on topics analyzes involving notions in tutorial and Practical lab works, and involving the general societal culture and students. The evaluation is in the form of oral presentations.</td></tr>
</table>

	O	**Molecular and cellular mechanisms of animal development**	**4 ects**	**20**	**10**	**10**	
			The objective is to enable students to understand the molecular basis related to the early stages of developing model organisms and to integrate the impact of the mechanisms that take place in the understanding of most human diseases and their current treatment perspectives. Models studies (nematode, Drosophila, echinoderms, amphibians, birds, mammals). Factors of differentiation of embryonic stem cells, germ line cells and determinism, genetic sex determination, establishment of early embryo fertilization, segmentation, gastrulation, mesoderm induction, neurulation, relations with pathologies. Tutorial works: primordial germ cells, gamete formation, reproduction. spiral division, cell cycle and oncology. Cell movements gastruction, migration and invasion. Right/left body asymmetry and effector common to many cancers.			
	O	**Animal cell plasticity and Ontogenesis**	**4 ects**	**20**	**8**	**12**	
			The objective of this unit is to enable students to become familiar with key concepts of cell plasticity and differentiation mechanisms. The following topics will be covered: characterization of cell plasticity of embryonic stem and adult, regeneration mechanisms, neurogenesis, somitogenesis, members, organogenesis of the eye and of the heart. Bio ethical aspects of the use of stem cells will be discussed, as well as the impact of deregulation of differentiation mechanisms in the understanding of current human pathologies (Teratology, carcinogenesis). Practical lab works: Approach bio ethics of using stem cells, the embryo and manipulations on animal tissues. Organogenesis of the heart and of the eye. Organogenesis of body members.			
	C	**Professionalisation:**	**4 ects**	Laws of works, knowledge of companies, Language 1 (2)			
	O	**Bilingual groups (Bil)**	Selected students in the bilingual groups will follow tutorial and practical lab courses in scientific english, both oral, written and exams. As the bilingual students choose different options, the group is teached in french. But many evaluations (oral, written reports, poster, dissertation) were performed in english (oral and written).				
	0	**Research supplement to the BSc degree**	Student can choose to undergo this 'Label'. It contains: 20h on business and companies knowledge, one month full-time internship in a research Lab, scientific report, and oral defence.				

Type*: compulsory (C) or optionnal (O)