PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA

MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

BACHELOR'S TRAINING OFFER

Establishment	Faculty	Department
Djilali Bounaama University of Khemis Miliana	Natural and Life Sciences & Earth Sciences	Biological Sciences

Field	Branch	Speciality
Natural and Life Sciences	Biotechnology	Microbial Biotechnology

Identity sheet of the training

Location of the training

Faculty: Natural and Life Sciences & Earth Sciences

Department: Biological Sciences

External partners

Other academic institutions:

- Saad Dahlab University of Blida 1
- Hassiba Benbouali University of Chlef
- Biotechnology Research Center (CRBt)
- National Higher School of Biotechnology (ENSB)

Socio-economic partners:

- Hospital laboratories (Khemis Miliana, Miliana, Ain Defla)
- Medical analysis laboratory
- SAIDAL

International partners:

- National Institute of Agronomic Research (INRAE) France
- Institute of Research for Development (IRD) France

Objectives

This program seeks to produce high quality graduates who are conversant in the areas of Biotechnology. The program is offered on a block release basis and is meant to cater for individuals that are already employed in various industries and research facilities. The students are introduced to advanced aspects of recombinant DNA technology, microbial genetics, food microbiology, industrial, medical and environmental biotechnology as well as entrepreneuship skills to enable them to start businesses in the various fields.

Targeted skills

In this training a number of typical biotechnological production processes and their historical development will be discussed. In these developments cellular and molecular aspects as well as process technology play a major role. The biotechnological production processes that are treated will give a broad overview of the use of biotechnology knowledge in the main application areas (pharmaceutical, medical, food and environmental technology application area). The students will also gain hands-on experience in setting-up and running a bench-top bioreactor. In this practical, the impact of cultivation conditions on production will be studied.

Employability

Production Managers, Quality controllers, Laboratory technicians in the food industry (baking, dairy etc), Pharmaceutical, Agricultural (seed production houses, feed manufacturers), Medical (Laboratories at diagnostic and medical centres). Research scientists in research institutions, lecturers at Universities and polytechnics, biology educators in the education sector. Some can proceed and pursue higher degrees. Some can become consultants or become entrepreneurs in biology related businesses.

Bridges to other specialties

Students enrolled in this program will still be able to move into biological science disciplines with program affinities, including Microbiology and Health, Food and Industrial Microbiology, Quality Control and Biotechnology.

Performance indicators

The training supervision team is composed of teachers specialized in the field to ensure the smooth running of the training; the availability of material resources such as the various teaching or research laboratories with adequate equipment.

The modalities of control of knowledge (final exam, questioning in TD, report of exit or TP, presentations...) are in conformity with the regulation in force. There is compensation between subjects within the UE and compensation between the UE by semester. A make-up session in the form of a written exam is planned for all the UE not acquired at the end of the semester.

Material resources

Pedagogical laboratories

Biochemistry and Molecular Biology Laboratory

Equipment	Number
Microscope	2
Hot plate	1
Precision scale	2
pH meter	5
Chromatography	3
Horizontal electrophoresis cells	1
Centrifugeuse	3
Water bath	2
Thermocycleur	1
Optical spectrophotometer	1
Oven	1
Refrigerator	1
Freezer (-20)	1
Hot plate	4
Heated magnetic stirrer	4
Vortex shaker	2
Generators 300 V	2

Microbiology Laboratory

Equipment	Number
Manual autoclave	2
Automatic autoclave	1
Incubator oven	2
Microscope	12
Bec bensen	20
Sterilizer oven	1
Colony counter	1
Refrigerator	1
Analytical balance	1
Water bath	1
Vertical laminar flow hood	1
Spectrophotometer	1
Stirrer	1

Biology Laboratory

Equipment	Number
Microscope	20
Analytical balance	6
Spectrophotometer	1
Thin layer chromatography	5
pH meter	1
Electric thermometer	8
Centrifuge	2
Water bath	3
Refrigerator	1
Hot plate	5
Magnetic stirrer	4
Precision scale	1
Oven	2

Semester organization of the courses

First semester

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
Fundamental unit (UEF)	*General and organic chemistry*	6	3	1h30	1h30	1h30	67h30
	Cell biology	8	4	1h30	1h30	3h00	90h00
	Mathematics and statistics	4	2	1h30	1h30		45h00
Methodological unit (UEM)	*Geology*	5	3	1h30	1h30	1h00	60h00
	Communication and expression Techniques	4	2	1h30	1h30		45h00
Discovery unit (UED)	*Working method and terminology*	2	2	1h30	1h30		45h00
Transversale unit (UET)	*Universal history of biological sciences*	1	1	1h30			22h30

Second semester

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
Fundamental unit (UEF)	*Thermodynamics and solution chemistry*	6	3	1h30	1h30	1h30	67h30
	Plant Biology	6	3	1h30		3h00	67h30
	Animal Biology	6	3	1h30		3h00	67h30
Methodological unit (UEM)	*Physics*	5	3	1h30	1h30	1h00	60h00
	Communication and expression techniques 2	4	2	1h30	1h30		45h00
Discovery unit (UED)	*Life sciences and socio-economic impacts*	2	2	1h30	1h30		45h00
Transversale unit (UET)	*Working method and terminology*	1	1	1h30			22h30

Third semester

Teaching unit	Matter	Credit	Coefficient	Course	TD	TP	HV
Fundamental unit (UEF)	*Introduction to biotechnology*	6	3	3h00	1h30		67h30
	Biochemistry	6	3	3h00	1h30		67h30
	Genetics	6	3	3h00	1h30		67h30
Methodological unit (UEM)	*Communication and expression techniques*	4	2	1h30	1h30		45h00
	Biophysics	5	3	1h30	1h30	1h00	60h00
Discovery unit (UED)	*Environment and sustainable development*	2	2	1h30	1h30		45h00
Transversale unit (UET)	*University ethics and deontology*	1	1	1h30			22h30

Fourth semester

Teaching unit	Matter	Credit	Coefficient	Course	TD	TP	HV
Fundamental Unit (UEF)	*Biotechnology and applications*	6	3	3h00	1h30		67h30
	Microbiology	8	4	3h00	1h30	1h30	90h00
	Immunology	4	2	1h30	1h30		45h00
Methodological unit (UEM)	*Scientific methodology and techniques for studying life*	4	2	1h30		1h30	45h00
	Biostatistics	5	3	1h30	1h30	1h00	60h00
Discovery unit (UED)	*General ecology*	2	2	1h30	1h30		45h00
Transversale unit (UET)	*Computer tools*	1	1	1h30			22h30

Fifth semester

Teaching unit	Matter	Credit	Coefficient	Course	TD	TP	HV
Fundamental unit (UEF)	*Elements of molecular genetics of microorganisms*	3	6	3h00	1h30		67h30
	Bacterial taxonomy	3	6	1h30		3h00	67h30
	Microbial biochemistry	3	6	3h00		1h30	67h30
Methodological unit (UEM)	*Molecular biology*	2	4	1h30	1h30		45h00
	Microbial genetics	3	5	1h30	1h00	1h30	60h00
Discovery unit (UED)	*Hygiene and safety in laboratories*	3	3	3h00		1h30	67h30

Six semester

Teaching unit	Matter	Credit	Coefficient	Course	TD	TP	HV
Fundamental unit (UEF)	*Environmental and infectious virology*	3	6	3h00	1h30		67h30
	Microbiological engineering	2	4	1h30	1h30		45h00
	Microbial ecology	4	8	3h00	1h30	1h30	90h00
Methodological unit (UEM)	*Microbiological control techniques*	3	5	1h30	1h00	1h30	60h00
	Biochemical analysis techniques	2	4	1h30		1h30	45h00
Transversale unit (UET)	*Documentation techniques*	3	3	1h30	3h00		67h30

Overall summary of the training

VH \ UE	UEF	UEM	UED	UET	Total
Course	675	180	112.5	90	1059
TD	337.5	135	22.5	45	540
TP	540	22.5	67.5	-	630
Personal work	1175	325	150	135	1785
Total	2728	663	353	270	4014
Credits	123	29	17	11	**180**
% in credits for each EU	60%	30%	5.90%	4.10%	100%

Program description

Module title: General and organic chemistry

Credits: 6

Coefficient: 3

Prerequisites

The student must know the basic notions of general and organic chemistry, namely the structure of the atom, atomic bonds and redox reactions.

Objectives

This course is designed to provide instruction in the basic organization and chemical structure of matter. It is a complement to the other courses as it serves to facilitate the chemical understanding of biological phenomena.

Contents

1. General chemistry

1.1. Generalities

1.1.1. Atom, nucleus, isotopy

1.1.2. Stability and cohesion of the nucleus, binding energy per nucleon,...

1.2. Radioactivity

1.2.1. Definition

1.2.2. Natural radioactivity: main types of radiation

1.2.3. Artificial radioactivity

1.2.4. Law of radioactive decay

1.2.5. Different types of nuclear reactions

1.3. Electronic Configuration of Atoms

1.3.1 Introduction of Quantum Numbers

1.3.2. Principles governing the electronic structure of an atom :

1.3.3. Energy rule (Klechkoweski rule)

1.3.4. Pauli's exclusion rule

1.3.5. Hund's rule

1.4. Periodic classification

1.4.1. Group (Column), Period (Line)

1.4.2. Evolution of the physical properties within the periodic table: atomic radius atomic radius, ionization energy, electronic affinity....

1.5. Chemical bonding

1.5.1 Introduction : strong and weak bonds

1.5.2. Representation of the chemical bond : Lewis diagram

1.5.3. Different types of strong bonds (covalent bond, ionic bond, metallic bond) metallic bond)

1.5.4. Ionic character of a covalent bond

1.5.5. Geometry of molecules: V.S.E.P.R theory (Gillespie rule)

2. Organic chemistry

2.1. Organic compounds, formulas, functions, nomenclature

2.1.1. Formulas of organic compounds

2.1.2. Functions, functional groups

2.1.3. Nomenclature

2.1.4 Study of organic functions

2.2. Reaction mechanisms in organic chemistry

2.2.1. Resonance and mesomerism

2.2.2. Conjugation

2.2.3. Stereochemistry

2.2.4. Electronic Effects

2.2.5. Nucleophilic Substitution

2.2.6. Eliminations

2.2.7. Radical Reactions

2.2.8. Reduction Reactions

2.2.9. Oxidation Reactions

Evaluation methods

Continuous assessment and semester exam

Module title: Cellular biology

Credits: 8

Coefficient: 4

Prerequisites

The student must have knowledge of general biology.

Objectives

The objectives of this course are to introduce students to the living world at the cellular level, to acquire the basic notions of the cell, eukaryotic and prokaryotic, and to study the cellular constituents. These objectives are reinforced by practical sessions in the laboratory.

Contents

1. General
    1.1. Classification and relative importance of the kingdoms
    1.2. Cell and cell theory
    1.3. Origin and evolution
    1.4. Cell types (Prokaryote, Eukaryote, Acaryote)
2. Methods of studying the cell
    2.1. Optical and electronic microscopy methods
    2.2. Histochemical methods
    2.3. Immunological methods
    2.4. Enzymological methods
3. Plasma membrane: structure and function
4. Cytoskeleton and cell motility
5. Cell adhesion and extracellular matrix
6. Chromatin, chromosomes and cell nucleus
7. Ribosome and protein synthesis
8. The endoplasmic reticulum-golgi apparatus system
9. The interphase nucleus
10. The endosomal system: endocytosis

11. Mitochondria
12. Chloroplasts
13. Peroxisomes
14. Extracellular matrix
15. Plant wall

Evaluation methods

Continuous assessment and semester exam

Module title: Mathematics, Statistics

Credits: 4

Coefficient: 2

Prerequisites

The student must have knowledge of functions, integrals and random variables.

Objectives

This course allows the student to integrate the statistical and computational tool in the biological field, and to use numerical analysis, probability and computation through the computer tool.

Contents

1. Mathematical analysis
   1.1. One-variable function, derivative and integrals
   1.2. Approximation method
   1.3. Series, positive term series, Rieman series
   1.4. Functions in several variables, partial derivatives, differentials
   1.5. Double and triple integrals
   1.6. Calculation of surfaces and volumes
2. Probabilities
   2.1. Random variables, BERNOULLI variables
   2.2. Statistical laws and bio-statistical applications
   2.3. Parameters and properties
   2.4. Distribution function and density function

Evaluation methods

Continuous assessment and semester exam

Module title: Geology

Credits: 5

Coefficient: 3

Objectives

This course allows students to see the constituents and structure of the globe, the interactions between these constituents, external and internal geodynamics.

Contents

1. General geology
   1.1. Introduction
   1.2. The terrestrial globe
   1.3. The Earth's crust
   1.4. Structure of the earth
2. External geodynamics
   2.1. Erosion
   2.2. Deposits
3. Internal geodynamics
   3.1 Seismology
   3.2. Volcanology
   3.3. Plate tectonics

Evaluation methods

Continuous assessment and semester exam

Module title: Communication and expression techniques

Credits: 4

Coefficient: 2

Objectives

This module aims at understanding and writing scientific documents in French as well as using and translating scientific terms.

Contents

1. Scientific Terminology

2. Study and comprehension of texts

3. Written and oral expression techniques (report, synthesis, use of modern means of communication)

4. Expression and communication in a group. Study of proposed texts (observation, analysis, review, written expression)

Evaluation methods

Continuous assessment and semester exam

Module title: Working Method and Terminology

Credits: 2

Coefficient: 2

Prerequisites

The student is expected to have some knowledge of bibliographic research.

Objectives

To help students design methods of research and synthesis of work according to scientific rules.

Contents

1. Introduction to bibliographic research
2. Writing a scientific report
3. Introduction to reading and understanding a scientific article

Evaluation methods

Continuous assessment and semester exam

Module title: Universal history of biological sciences

Credits: 1

Coefficient: 1

Objectives

This program should emphasize the history of biology, and the question of life across eras and civilizations. It should emphasize the place of technical progress in the evolution of biology.

Contents

1. Prehistory
2. Antiquity
3. Middle Ages
   3.1. In the West
   3.2. In the East (Muslim civilization)
4. Sixteenth and seventeenth centuries:
5. Eighteenth century: Darwin
6. Nineteenth century: Cell theory (microscopy), Sexuality Embryology, Biology Molecular (DNA) Genetics
7. Twentieth century: gene therapy and cloning

Evaluation methods

Semester exam

Module title: Thermodynamics and chemistry of mineral solutions

Credits: 6

Coefficient: 3

Prerequisites

The student must have knowledge of redox reactions.

Objectives

This course provides an understanding of the principles governing the transformation and interaction of matter, the principle of thermodynamics, energy equilibrium, and the kinetics of chemical reactions.

Contents

1. Chemical equilibrium
   1.1. Acid-base equilibrium
      1.1.1. Definition according to: Arrhenius, Bronsted, Lewis
      1.1.2. Equilibrium constant: dissociation of water, acidity and basicity
      1.2.3. The pH: of water, of a strong monobasic acid, of a strong monobasic acid, ...
   1.2. Redox equilibrium
      1.2.1. Redox reaction: electron transfer
      1.2.2. Oxidation number
      1.2.3. Writing redox reactions
      1.2.4. Electrochemical Cells
      1.2.5. Redox Potential
   1.3 Precipitation Equilibrium: Solubility and Solubility Product
      1.3.1. Definition
      1.3.2. Effect of the addition of an ion on the solubility
      1.3.3. Effect of pH
2. Chemical kinetics
   2.1. Definition
   2.2. Reaction rate
   2.3. Expression of the rate law and order of a reaction

2.4. Factors influencing the speed of reaction

3. Thermodynamics

3.1. Thermodynamic systems and quantities: Functions and transformations thermodynamic transformations

3.2. First principle of thermodynamics

3.2.1. Expression of work and heat

3.2.2. Expression of internal energy and enthalpy

3.3. Second principle of thermodynamics

3.3.1. Expression of the entropy

3.3.2. Expression of the free energy and the free enthalpy

3.4. Thermochemistry

3.4.1. Heat of reactions

3.4.2. Enthalpy of reactions

3.4.3. Calculation of the internal energy of a reaction

3.4.5. Kincgoff's law

3.4.6. Hess's Law

3.5. Prediction of the direction of reactions

3.5.1. Isolated systems

3.5.2. Calculation of reaction entropies

3.5.3. Reactions at constant temperature

3.5.4. Calculation of the free enthalpy and free energy of a system.

4. Inorganic Chemistry

Evaluation methods

Continuous assessment and semester exam

Module title: Plant biology

Credits: 6

Coefficient: 3

Prerequisites

The student must have some knowledge of the different parts of a plant.

Objectives

The objective of this course is to teach students the fundamental principles of plant tissue organization and development.

Contents

1. Introduction to plant biology
2. Different types of tissues

2.1. Primary meristem (root and cell)

- 2.1.1. Primary tissues
- 2.1.2. Protective tissues (epidermis)
- 2.1.3. Filling tissues (parenchyma)
- 2.1.4. Support tissues (collenchyma and sclerenchyma)
- 2.1.5. Conductive tissues (primary xylem, primary phloem)
- 2.1.6. Secretory tissues

2.2 Secondary (lateral) meristems (cambium and phellogen)

- 2.2.1. Secondary tissues
- 2.2.2. Conductive tissues (secondary xylem and secondary phloem)
- 2.2.3. Protective tissues (suber or cork, phelloderma)

3. Anatomy of higher plants

3.1. Study of the root

3.2. Study of the stem

3.3. Study of the leaf

3.4. Comparative anatomy between mono- and dicotyledons

4. Morphology of higher plants and adaptation

4.1. Roots

4.2. Leaves

4.3. Stems

4.4 Flowers

4.5. Seeds

4.6. Fruits

5. Gametogenesis

5.1. Pollen grain

5.2. Ovule and embryo sac

6. Fertilization

6.1. Egg and embryo

6.2. Notion of development cycle

Evaluation methods

Continuous assessment and semester exam

Module title: Animal biology

Credits: 6

Coefficient: 3

Objectives

This module consists of introducing students to the particularities of the developmental biology of certain animal species.

Contents

Part I: Embryology

1. Introduction
2. Gametogenesis
3. Fertilization
4. Segmentation
5. Gastrulation
6. Neurulation: fate of the leaflets
7. Delimitation: appendages of birds
8. Particularities of human embryology (Cycle, nidation, evolution of annexes, placenta)

Part Two: Histology

1. Coating epithelia
2. Glandular epithelia
3. Connective tissues
4. Blood tissues
5. Cartilaginous tissues
6. Bone tissue
7. Muscle tissues
8. Nerve tissue

Evaluation methods

Continuous assessment and semester exam

Module title: Physics

Credits: 5

Coefficient: 3

Prerequisites

Students must have a basic understanding of mathematics and mechanics.

Objectives

The objective of this course is to enable students to acquire knowledge related to the basic notions of physics that can be exploited in the SNV field.

Contents

1. Mathematical reminder

    1.1. Physical quantities and dimensional analysis

    1.2. Calculation of errors (different types of errors, calculation of uncertainties and significant figures).

2. Optics

    2.1. Introduction (objective of optics)

    2.2. Nature of light (spectrum of electromagnetic waves, photons, waves...)

    2.3. Geometrical optics

3. Fluid Mechanics

    3.1. Definition and characteristics of a fluid.

    3.2. Hydrostatics (Fundamental relation of hydrostatics, buoyancy, float)

    3.3. Hydrodynamics (deed, continuity equation, Bernoulli's theorem)

4. Notion of crystallography

5. Notions of spectral analysis

Evaluation methods

Continuous assessment and semester exam

Module title: Communication and expression techniques 2

Credits: 4

Coefficient: 2

Objectives

This course completes the learning of understanding and writing scientific documents in English.

Contents

1. Scientific Terminology

2. Study and comprehension of texts

3. Written and oral expression techniques (report, synthesis, use of modern means of communication)

4. Expression and communication in a group. Study of proposed texts (observation, analysis, review, written expression)

Evaluation methods

Continuous assessment and semester exam

Module title: Life sciences and socio-economic impacts

Credits: 2

Coefficient: 2

Objectives

To help students conceive of careers directly or indirectly related to the various specialties of the natural and life sciences.

Contents

1. Animal and plant production (breeding, processing, production...)
2. Toxicology and environmental health (effect of pollutants on plant and animal life and on human health)
3. Biology and health (talk about the interest of biology in the diagnosis of animal and plant diseases)
4. Biotechnology and molecules of interest (pharmaceutical and food industry)
5. Biology and forensics
6. Terrestrial and marine ecosystems (park management, ...)
7. Technical-commercial biology (e.g.: commercial delegate)

Evaluation methods

Continuous assessment and semester exam

Module title: Working method and terminology 2

Credits: 1

Coefficient: 1

Prerequisites

The student is expected to have some knowledge of bibliographic research.

Objectives

To help students design methods of research and synthesis of work according to scientific rules.

Contents

1. Terminology
2. Writing a scientific report
3. Introduction to reading and understanding a scientific article

Evaluation methods

Semester exam

Module title: Introduction to biotechnology

Credits: 6

Coefficient: 3

Objectives

This course is interested in giving a global overview of the fields of application of biotechnology (environment, agronomy, industry and medicine).

Contents

1. Introduction
2. Biotechnologies applied to environmental issues
   - 2.1. Climate change and evolution of ecosystems
   - 2.2 Management of microbiological, plant and animal resources
   - 2.3. Agro-environmental pollution (water, air, soil)
3. Biotechnologies in agronomy for food purposes
   - 3.1. Bioprocessing and conservation
   - 3.2. Production of food matrices in bioreactors
   - 3.3. Food safety, traceability and quality
4. Biotechnology and industry for non-food purposes
   - 4.1. Bioenergy
   - 4.2. Biomaterials and agro-polymers
   - 4.3. Biomolecules and cellular activities
5. Microbial biotechnologies and infectiology
   - 5.1. Diagnostics
   - 5.2. New therapeutic approaches
   - 5.3. Fight against doping and the use of drugs

Evaluation methods

Continuous assessment and semester exam

Module title: Biochemistry

Credits: 6

Coefficient: 3

Prerequisites

The student must have some knowledge of chemical bonds (weak and strong) and physicochemical properties of organic molecules.

Objectives

This teaching unit consists of teaching the fundamentals of biochemistry and enzymology, and familiarizing students with biochemical techniques.

Contents

1. Chemical bonds
    1.1. Strong bonds
    1.2. Weak bonds
2. Structure and physicochemical properties of carbohydrates

2.1. Simple bones
    2.2. Oligosides
    2.3. Polyholosides, heterosides.
3. Structure and physicochemical properties of lipids
    3.1. Simple lipids
    3.2. Complex lipids
4. Structure and physicochemical properties of amino acids, peptides and proteins
    4.1. Amino acids, peptides, proteins
    4.2. Structure (primary and secondary, tertiary and quaternary)
    4.3. Properties and effect of treatments (solubility, electro-phoretic behavior, denaturation.)
    4.4. Separation of proteins
5. Concepts of enzymology
    5.1. Definition, classification
    5.2. Mechanisms of action

5.3. Active site

5.4. Enzymatic kinetics and types of representation

5.5. Enzymatic inhibition

5.6. Allostery phenomenon

6. Concepts of bioenergetics

6.1. Types of chemical reactions

6.2. The respiratory chain and energy production

6.3. Phosphorylation and redox reaction

7. Carbohydrate metabolism

7.1. Catabolism (glycolysis, glycogenolysis, pentose phosphate pathway, Krebs cycle, energy balance)

7.2. Anabolism (neoglucogenesis and glycogenesis)

7.3. Regulation

8. Lipid metabolism

8.1. Catabolism of fatty acids (Beta-oxidation)

8.2. Catabolism of sterols

8.3. Biosynthesis of fatty acids and triglycerides

8.4. Sterol biosynthesis

8.5. Regulation

9. Peptide and protein metabolism

9.1. Catabolism of amino groups

9.2. Catabolism of carboxyl groups

9.3. Catabolism of the side chain

9.4. Glucoforming and ketogenic acids

9.5. Biosynthesis of essential amino acids

9.6. Nitrogen elimination, urea cycle

9.7. Example of peptide biosynthesis (case of peptides with biological activity)

9.8. Example of protein biosynthesis

9.9. Regulation

10. Structure and metabolism of other compounds of biological interest

Evaluation methods

Continuous assessment and semester exam

Module title: Genetics

Credits: 6

Coefficient: 3

Prerequisites

The student must have knowledge on nucleic acids and Mendelian genetics.

Objectives

This course introduces the student to the concepts and terminology of genetics, trait transmission, DNA structure, replication, transcription, alterations and mechanisms of regulation of gene expression.

Contents

1. Genetic material
   1.1. Chemical nature of genetic material
   1.2. Structure of nucleic acids (DNA-RNA)
   1.3. DNA replication: in prokaryotes and eukaryotes
   1.4. Organization into chromosomes
2. Transmission of genetic characters in eukaryotes
3. Genetics of haploids
   3.1. Independent genes
   3.2. Linked genes
   3.3. Genetic mapping
4. Genetics of diploids
   4.1. Independent genes
   4.2. Linked genes
   4.3 Genetic mapping
5. Bacterial and viral genetics
   5.1. Conjugation
   5.2. Transformation
   5.3. Transduction
   5.4 Mixed infection in viruses

6. Protein synthesis
   6.1. Transcription
   6.2. Genetic code
   6.3. Translation
7. Genetic mutations
8. Chromosomal mutations
   8.1. Structural variation
   8.2. Numerical variation (human example)
9. Gene structure and function: biochemical genetics
10. Regulation of gene expression
   10.1. Lactose operon in prokaryotes
   10.2. Example in eukaryotes
11. Notions of extra-chromosomal genetics
12. Notion of population genetics

Evaluation methods

Continuous assessment and semester exam

Module title: Communication and expression techniques

Credits: 4

Coefficient: 2

Prerequisites

Some notions of terminology and research methodology acquired in L1.

Objectives

Learn and apply research methods and the collection of useful and essential information for synthesis and written formatting (report, oral, defense). Application of English grammar in a scientific context.

Contents

1. Study of proposed texts (observe, analyze, review, written expression)
2. Terminology
3. Methodology of bibliographic research.
4. Methods of writing scientific reports.

Evaluation methods

Semester exam

Module title: Biophysics

Credits: 5

Coefficient: 3

Objectives

The objective of the biophysics course is to provide SNV students with a basic understanding of physics.

Contents

1. The states of matter

1.1. Gases: elements of kinetic theory, equation of state of perfect or real gases, changes of state

1.2. Liquids: structure of water, dissolution

1.3. Solids: different structures

1.4. Intermediate states: glasses, liquid crystals, granular states, deformable polymers

2. Generalities on aqueous solutions

2.1. Study of solutions: classification of solutions

2.2. Concentrations: molar fraction, molarity, molality, weight concentration, osmolarity, equivalent concentration.

2.3. Solubility

2.4. Electrolyte solutions: electrical conductivity, physical and chemical properties of electrolytes

3. Surface phenomena

3.1. Surface tension: definition, measurements and biological applications

3.2. Capillarity phenomenon: definition, measurements and biological applications

3.3. Adsorption

4. Diffusion phenomenon

4.1. Diffusion

4.2. Osmosis phenomenon and osmotic pressure: definition, measurements and biological applications

4.3. Permeability: definition, measurements and biological applications

5. Study of viscosity

5.1. Laminar and turbulent flow

5.2. Viscous resistance and viscosity measurements

5.3. Sedimentation

6. Sound and Ultrasonic Waves

6.1. The sound wave and its properties: production, nature and classification of sound waves.

6.2. The Doppler effect: definition, measurements and biological applications.

6.3. Ultrasound: definition, measurements and biological applications.

Evaluation methods

Continuous assessment and semester exam

Module title: Environment and sustainable development

Credits: 2

Coefficient: 2

Objectives

The objective of this course is to make students aware of the issues, contents and actions of sustainable development. It is about making them aware that it is possible to act for the preservation of the environment, through their education, as well as at their level, on their consumption, their daily activities and their society. During their university education, whatever their specialization and their ambition for their future career, students will have the opportunity to learn and experience their knowledge of sustainable development.

Contents

1. Definitions: Environment, components of an environment, sustainable development.

2. Meaning of development?

→ The main dimensions of the environmental crisis: human demography, global warming, fossil fuels (non-renewable), depletion of natural resources, drinking water, biodiversity and agriculture

→ Sustainable development, why?

→ The concept of sustainable development

→ The fields of sustainable development

→ The principles of sustainable development and their origins: precaution, prevention, responsibility, solidarity, equity, polluter pays

→ Some indicators of sustainable development: ecological footprint and bio capacity, environmental impact, environmental performance index, human development index, GDP: gross domestic product (economic) and school enrolment rate boys/girls (societal), accessibility to healthcare (societal)

→ Environmental education, nature awareness and animation, environmental communication

Evaluation methods

Continuous assessment and semester exam

Module title: University Ethics and Deontology

Credits: 1

Coefficient: 1

Objectives

The objective of this course is to enable SNV students to acquire the resources of professional ethics.

Contents

1. Introduction: Contexts of the Algerian university
2. Concepts
    - 2.1. Moral
    - 2.2. Ethics
    - 2.3. Deontology
    - 2.4. Law
    - 2.5. Professional values
    - 2.6. Learning and teaching
    - 2.7. Didactics and pedagogy
3. The charter of ethics and academic conduct
    - 3.1. Basic principles
    - 3.2. Rights
    - 3.3. Obligations and duties
4. Applications
    - 4.1. Teaching: courses, evaluation of knowledge and behaviour
    - 4.2. Scientific research: research methodology, plagiarism, copyright, scientific writing

Evaluation methods

Continuous assessment and semester exam

Module title: Biotechnologies and applications

Credits: 6

Coefficient: 3

Objectives

This course focuses on describing the user sectors of biotechnology.

Contents

1. The economic significance of microorganisms
2. Use of microorganisms in food fermentations
   - 2.1. Bread
   - 2.2. Cheese
   - 2.3. Milk
   - 2.4. Other
3. Microbial metabolites of economic importance
   - 3.1. Enzymes
   - 3.2. Ethanol
   - 3.3. Citric acid
   - 3.4. Antibiotics
4. Application of biotechnologies in the medical field
   - 4.1. Production of hormones
   - 4.2. Production of vaccines
5. Application of biotechnologies in the animal field
   - 5.1. Biotechnology of the embryo
   - 5.2. Animal cell culture for industrial production
4. Application of biotechnologies in the medical field
   - 4.1. Historical overview of the development of in vitro cultures
   - 4.2 Totipotency
   - 4.3. In vitro culture and its use

Evaluation methods

Continuous assessment and semester exam

Module title: Microbiology

Credits: 8

Coefficient: 4

Prerequisites

The student must have a global notion of pathogens.

Objectives

The student will learn about the microbial world, techniques used to observe microorganisms, bacterial growth and classification.

Contents

1. The microbial world
   1.1 History
   1.2. Place of microorganisms in the living world
   1.3 General characteristics of the prokaryotic cell
2. The bacterial cell
   2.1. Observation techniques of the bacterial cell
   2.2. Cell morphology
   2.3. The cell wall
   2.4. The plasma membrane
   2.5. The cytoplasm
   2.6. The chromosome
   2.7. Plasmids
   2.8. Pilli
   2.9. The capsule
   2.10. Cilia and flagella
   2.11. The spore
3. Bacterial classification
   3.1. Phenetic classification
   3.2. Phylogenic classification
   3.3. Bergey's classification

4. Bacterial nutrition
    4.1. Basic needs
    4.2 Growth factors
    4.3. Trophic types
    4.4. Physico-chemical parameters (temperature, pH, O2 and aW)
5. Bacterial growth
    5.1. Measurement of growth
    5.2. Growth parameters
    5.3. Growth curve (batch culture)
    5.4. Bacterial culture
    5.5. Antimicrobial agents.
6. Concepts of mycology and virology
    6.1. Mycology (yeast and mould)
    6.2. Virology

Evaluation methods

Continuous assessment and semester exam

Module title: Immunology

Credits: 4

Coefficient: 2

Prerequisites

The student must have a basic understanding of the immune system.

Objectives

The objective of this course is to acquaint students with the role of immunity, immune defense systems, types of immune response and immune system dysfunction.

Contents

1. Introduction to immunology
   1.1. Role of immunity
   1.2. Relationship with daily life and the great discovery
2. Ontogenesis of the immune system
   2.1. B cells and lymphoid organs
   2.2. T cells
   2.3. Education of B cells within the marrow
   2.4. Education of T cells inside the thymus
   2.5. Other cells (myeloid cells)
3. MHC
4. The non-specific immune response
5. The specific immune response
   5.1. Cellular
   5.2. Humoral
6. Cellular and humoral cooperation
   6.1. Cooperation between different cells
   6.2. Cytokines
7. Dysfunction of the immune system

8. The main tests in immunology
   8.1. Agglutination
   8.2. Immunoprecipitation
   8.3. Immunoelectrophoresis
   8.4. Immunofluorescence
   8.5. Elisa Techniques

Evaluation methods

Continuous assessment and semester exam

Module title: Scientific methodology and techniques for studying life

Credits: 4

Coefficient: 2

Objectives

This course allows students to have notions on the methods applied to the study of the living: Cytological methods, methods of study of the biochemical composition of the cells and the techniques of approach to the living.

Contents

1. General introduction: Different scientific practices on observation (descriptive methods), manipulation (analytical methods) and exploration (synthetic methods) of animal and plant life.

Part I: Methods for studying cell morphology

I. Cytological methods

1. Microscopy

1.1. Light microscopes or photonic microscopes

- ✓ Transmission microscopes
- ✓ Other photonic microscopes

1.2. Electron microscopes

- ✓ The transmission electron microscope
- ✓ The scanning electron microscope

II. Methods for studying the biochemical composition of cells

1. Cellular materials

1.1 Whole cells or cell sections

1.2. Cellular shreds = cellular homogenates (Different techniques can be used)

1.3. Cellular fractions

2. The methods

2.1. Electrophoresis

2.2. Biochemical analysis and dosage methods

2.2. Cytochemical methods.

2.3 Immun cytology / immunology technique.

III. Genetic engineering techniques (DNA sequencing)

Part II: Methods and techniques for approaching the living

1. The herbarium: Collection of dry plants, indispensable basis for research.
2. Techniques of approach to living organisms.
   2.1. Breeding
   2.2. Cultures
   2.3. Collections
   2.4. Dissections
3. Access to demographic parameters of animal and plant populations.

Evaluation methods

Continuous assessment and semester exam

Module title: Biostatistics

Credits: 5

Coefficient: 3

Prerequisites

The student must have notions of probability and numerical analysis already seen in the first year.

Objectives

The objective of this course is to provide certain methodological tools classically used to describe and test biological phenomena.

Contents

1. Reminders

1.1 Reminders on descriptive statistics

- 1.1.1. Parameters of positions
- 1.1.2. Parameters of dispersion
- 1.1.3. Shape parameters

2. Recall the main distribution laws: normal and log normal, Student, Pearson, Fischer-Snedecor...

3. Statistical Inference: Hypothesis Testing

- 3.1 Conformity test
- 3.2. Comparison test
- 3.3. Test of independence

4. Correlation study and Regression

- 4.1. Correlation coefficient
- 4.2 Significance test of the correlation
- 4.3. Simple linear regression

5. One and two factor analysis of variance

Evaluation methods

Continuous assessment and semester exam

Module title: General ecology

Credits: 2

Coefficient: 2

Objectives

The objective of this course is to provide students with an understanding of the concept of an ecosystem, the abiotic and biotic factors and the interactions between these factors, the components of the ecosystem and its functioning.

Contents

Chapter 1

1.1. Definition of the ecosystem and its constituents (Notions of biocenosis and ecological factor.)

1.2. Areas of intervention

Chapter 2: The factors of the environment

2.1. Abiotic factors

- 2.1. Climatic
- 2.2. Edaphic
- 2.3. Hydric

2.2. Biotic factors

- 2.2.1. Competitions
- 2.2.2.Pests and Predators
- 2.2.3 Cooperative and symbiotic interactions
- 2.2.4. Parasitism

2.3 Interaction of environments and living beings

- 2.3.1. Role of ecological factors in the regulation of populations
- 2.3.2. Notion of ecological optimum
- 2.3.3. Ecological valence
- 2.3.4. Ecological niche.

Chapter 3: Structure of ecosystems

3.1 Structure of food chains; relationships between producers (autotrophs) and their dependence on nutrients and light or chemical energy

3.2. Consumers (Heterotrophs) who are linked to producers and finally decomposers who ensure the recycling and mineralization of organic matter.

Chapter 4: Functioning of ecosystems

4.1. Energy flows in the biosphere

4.2. Notions of ecological pyramids, production, productivity and bioenergy yield

4.3. Circulation of matter in ecosystems and main bio-geochemical cycles

4.4 Influence of human activities on biological equilibrium and particularly on the disruption of bio-geochemical cycles (consequences of pollution of aquatic environments and atmospheric pollution (eutrophication, greenhouse effect, ozone, acid rain.)

Chapter 5: Summary description of the main ecosystems

5.1. Forest, grassland, surface water, ocean

5.2 Evolution of ecosystems and the notion of climax

Evaluation methods

Continuous assessment and semester exam

Module title: Computer tools

Credits: 1

Coefficient: 1

Objectives

Introduction to the basic definitions of the operating system of computer resources. At the end of this course, the student will be able to design documents and tables in Word and Excel.

Contents

1. Discovery of the operating system
   1.1. Definition of an OS
   1.2. Different existing OS: Windows, Linux and Mac OS.
2. Discovery of the office suite
   2.1. Designing documents with WORD.
   2.2. Designing tables with EXCEL.
   2.3. Designing a presentation with Powerpoint.
   2.4. Introduction to Latex.
3. Software and Algorithms
   3.1. Definition of software.
   3.2. Definition of algorithmic.
   3.3. Use of algorithms in biology.

Evaluation methods

Semester exam

Module title: Elements of molecular genetics of microorganisms

Credits: 6

Coefficient: 3

Prerequisites

This unit requires in particular knowledge of general microbiology, but also knowledge of genetics, structural biochemistry and virology.

Objectives

This unit focuses on structural aspects and genetic and molecular mechanisms involved in gene expression in bacteria, eukaryotic microorganisms and viruses. Fundamental knowledge will be acquired on the organization and functioning of the microbial genome and the ability to compare with that of higher eukaryotes (human).

Contents

Part 1: Bacteria

Chapter 1: The bacterial genome

1. Structure of the bacterial genome
    - 1.1. The bacterial chromosome
    - 1.2. Mobile genetic elements
    - 1.3 Organization of prokaryotic genes
2. Replication of the bacterial genome
3. Alterations and repair mechanisms of the bacterial genome

Chapter 2: Horizontal gene transfer

1. Transformation
2. Conjugation
3. Transduction
4. Genetic map

Chapter 3: Protein biosynthesis

1. Transcription
2. Mechanism of translation

Chapter 4: Regulation of gene expression

1. Definition and concept of the operon
2. Inducible operons: Lactose operon
3. Repressible operons: Tryptophan operon
4. Expression modulator system: attenuation
5. Regulation by DNA sequence inversion

Part 2: Fungi (Yeast as a model system)

1. Reminders on the biology of yeast
2. The yeast genome
3. The yeast transcriptome
4. The yeast proteome
5. Analysis of biochemical mutations, tetrads
6. Complementation and gene conversion
7. Genetics of mitochondria

Evaluation methods

Continuous assessment and semester exam

Module title: Bacterial taxonomy

Credits: 6

Coefficient: 3

Objectives

This teaching should lead to a bacteriological diagnosis of all bacteria and archaea according to the data of the new edition of Bergey's Manual (Vol 1, 2, 3, 4 and 5). In addition to the classical characteristics of prokaryotes, the contribution of the molecular tool on which the Bergey's Manual is based for the identification of bacteria and Archaea is of great importance.

Contents

1. Introduction to systematics (Definitions, different taxonomic approaches)
2. The different bacterial and archaeal groups
3. The major bacterial phyla according to the Bergey's Manual classification: biology, taxonomy, morphology and ecology:

Class 1: Alphaproteobacteria

Class 2: Betaproteobacteria

Class 3: Gammaproteobateria

Class 4: Epselonproteobateria

4. The five Phyla of Archaea:

✓ Euryarchaeota.

✓ Crenarchaeota

✓ Koraarchaeota

✓ Nanoarchaeota

✓ Taumarchaeota

Evaluation methods

Continuous assessment and semester exam

Module title: Microbial biochemistry

Credits: 6

Coefficient: 3

Objectives

This unit should enable the student to characterize and identify bacteria and archaea biochemically.

Contents

1. Introduction: Energy, anabolism, catabolism
2. Energy metabolism of microorganisms
3. Catabolism of carbohydrates
4. Study and interest of some metabolic types
5. Catabolism of other organic compounds
6. Anabolism and production of biomass and metabolites

Evaluation methods

Continuous assessment and semester exam

Module title: Molecular biology

Credits: 4

Coefficient: 2

Prerequisites

Sufficient knowledge of genetics, biochemistry and bioinformatics.

Objectives

Fundamental knowledge of genetics and its applications in the field of biotechnology.

Contents

1. Concept of gene and transmission of genetic information
2. Structure and function of genes
3. Regulation of gene expression
4. Gene prediction
5. Protein sequence comparison
6. Mutation and DNA repair mechanisms: Mutation size, mutagenic effect, mutagenic agents, DNA repair mechanisms
7. Genetic recombination and transposable genetic elements
8. Gene transfers

Evaluation methods

Continuous assessment and semester exam

Module title: Microbial genetics

Credits: 5

Coefficient: 3

Prerequisites

Sufficient knowledge of molecular biology and biochemistry.

Objectives

Fundamental knowledge will be gained about the organization and function of the microbial genome and the ability to compare with that of higher eukaryotes.

Contents

1. Structure and organization of genetic material: chromosome, plasmids, viral genetic material.
2. Mutation and DNA repair mechanisms: Mutation size, mutagenic effect, mutagenic agents, DNA repair mechanisms.
3. Genetic recombination and transposable genetic elements: homologous recombination, site-specific recombination, transposable genetic elements and applications
4. Genetic transfers in bacteria: genetic analysis and construction: conjugation, transformation, transduction and transducing phages, applications, genetic mapping.
5. Restriction modification phenomenon: restriction modification system, restriction enzymes, restriction mapping and applications.
6. Regulation of gene expression: transcriptional regulation (examples: E. coli, Saccharomyces cerevisiae), translational regulation.
7. Bacteriophage genetics: viral genome replication, genetic recombination in viruses, mechanisms of gene expression cascade in viruses and maintenance in the prophage state.

Evaluation methods

Continuous assessment and semester exam

Module title: Hygiene and safety in laboratories

Credits: 3

Coefficient: 3

Prerequisites

The student must know the aspects related to chemistry, microbiology and legislation.

Objectives

This course aims to introduce students to the risks in a research laboratory. This initiation aims to alert students to the risks and to give them some keys to integrate a laboratory and prepare their manipulations.

Contents

1. Organization of the laboratories
   - Basic facilities
   - Chemical storage
2. Laboratory hygiene
3. Risks of handling in laboratories
   - Chemical risks (dangerous chemicals, explosions, poisoning)
   - Physical risks (fire, radioactivity, etc.)
   - Biological risks
4. Safety measures in laboratories
5. Waste management
6. Emergency measures in case of accidents
   - Procedure in case of spillage of chemical and biological liquids
   - What to do in case of fire
   - What to do in the event of an accident to a person

Evaluation methods

Continuous assessment and semester exam

Module title: Environmental and infectious virology

Credits: 6

Coefficient: 3

Objectives

To acquire the theoretical bases of virology and the techniques of environmental and infectious virology: to know what a virus is at the structural and molecular level.

Contents

1. General characteristics of viruses

2. The nucleic acids of viruses

3. Viral cycle

4. Replication of viral genetic material

4.1. Replication of DNA viruses (study model: T4 bacteriophage). Microorganism-environment interaction: migrations towards more hospitable places (tactism)

4.2 Microorganism-microorganism interaction: Notion of biofilms

4.3. Tools of microbiology: conventional methods, interest and limits. Environmental metagenomics. Viruses (human) in the environment

4.4. Emerging microorganisms in human health

4.5. Virus-host interaction: the different stages of viral infection, selected examples.

Evaluation methods

Continuous assessment and semester exam

Module title: Microbiological engineering

Credits: 4

Coefficient: 2

Prerequisites

Sufficient knowledge of general microbiology, genetics, and biochemistry.

Objectives

The objective of this module is to give the student a basic understanding of the different uses of microorganisms.

Contents

1. Definitions

   - Quantities and reactors

   - Microbiological processes

   - Yields of biological processes in reactors.

2. Kinetic models of microbial growth

3. Modeling of the reactor with non-renewed medium

3. Processes in enzymatic reactors - sizing and performance

4. Sterilization: processes and procedures

5. Scale-up from laboratory via pilot to industrial scale

6. Bioseparations engineering

7. Idealized recovery process: primary separation, isolation, purification, polishing

8. Separation devices in industrial cell culture: the continuous perfused cell retention reactor. Advantages and limitations of each design in an industrial context

Evaluation methods

Continuous assessment and semester exam

Module title: Microbial ecology

Credits: 8

Coefficient: 4

Objectives

The objective of this course is to present basic concepts on: i) interactions between microorganisms and the physical environment, ii) interactions between microorganisms, iii) interactions with higher organisms.

Contents

1. Interactions between microorganisms and the physical environment

Ecology of microorganisms in simple or complex ecosystems. Example of the soil, a complex medium and a microbial bioreactor. Spatial organization of the microbial community and biofilms.

2. Interactions between microorganisms

Signals and communication. Quorum sensing. Interactions and dynamics of microbial populations. Microbial successions: consequences for the biodegradation of organic compounds and in agronomy.

3. Interactions with higher organisms: The different types of interactions. Symbiosis and parasitism.

Microorganisms/plant interactions, colonization processes, ecological impact of GMOs.

Evaluation methods

Continuous assessment and semester exam

Module title: Microbiological control techniques

Credits: 5

Coefficient: 3

Objectives

This course allows the study of the techniques of analysis and microbiological control: i) general handling techniques; ii) techniques of estimation of microbial populations; iii) techniques of study and microbial identification.

Contents

1. Introduction: reminders of general microbiology

2. General handling techniques:

- Basic microbiological equipment and techniques

- Media and general culture techniques

- Selection and isolation techniques

2. Techniques for estimating microbial populations

3. Microbial study and identification techniques:

- Microscopic study

- Biochemical and physiological study

- Immunological study

4. Application to the study of the main microbial groups

- Techniques for the study of bacteria

- Techniques for the study of yeasts

- Techniques for the study of molds

- Other microorganisms.

Evaluation methods

Continuous assessment and semester exam

Module title: Biochemical analysis techniques

Credits: 4

Coefficient: 2

Objectives

The teaching of biochemical analysis techniques aims to develop in students the concepts of biochemical methods involved in food and medical control.

Contents

1. General introduction.
2. Chromatographic methods
3. Electrophoresis of proteins
4. Spectroscopic methods
5. Fluorometry.
6. Polarimetry
7. Separation methods: dialysis, electrodialysis, ultrafiltration, centrifugation, sedimentation
8. Isotonic methods
9. Antigen-antibody reaction
10. Immunohistochemistry

Evaluation methods

Continuous assessment and semester exam

Module title: Documentation techniques

Credits: 3

Coefficient: 3

Objectives

Present the basic rules of bibliographic research, write bibliographic references for the main types of documents and use a scientific article.

Contents

1. General

2. Information retrieval and management :

   - Scientific literature (primary and secondary sources)
   - Access to information
   - Strategy of a bibliographic search
   - Principles of bibliographic references

3. How to conduct a search?

4. Research questions

   - Sources of research ideas
   - Hypotheses: how to formulate...?
   - How to structure the essay?

Evaluation methods

Continuous assessment and semester exam