PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA

MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

Hassiba Benbouali university of Chlef

Academic Master's degree in Microbiology

Establishment	Faculty	Department
Hassiba Benbouali University, Chlef	Natural and Life Sciences	Biology

Domain: Nature and Life Sciences

Branch : Biological sciences

Specialty: Microbiology

II - Semester organization chart

(Please present all 4 semester cards)

: Teaching units	Half-yearly hourly volume	Weekly Hourly Volume				Coeff	Credits	Evaluation	
	14-16 wks	Courses	theatrical	Practical works	Other works			Continuous 40%	Exam 60%
Fundamental EU									
UEF1(O/P)									
UEF11: Microbiology and health	67h30	1h30	1h30	1h30	82h30	3	6	X	X
UEF12 : Bacterial physiology	67h30	3h		1h30	82h30	3	6	X	x
UEF2(O/P)									
UEF21: Molecular Virology and medical	67h30	3h	1h30		82h30	3	6	X	X
EU methodology									
UEM1(O/P)									
UEM11: Origins, evolution, eukaryotic diversity	60h	1h30	1h30	1h	65h	3	5	x	X
UEM12 Bioreactor and biotechnology of microorganisms	45h	1h30	1h30		55h	2	4	x	X
EU discovery									
UED1(O/P)									
UED11 Digital ecology	45h	1h30	1h30		5	2	2	X	x
Cross-disciplinary courses									
UET1(O/P)									
UET11: Communication scientific	22h30	1h30			2h30	1	1	/	X

Total Semester 1	**375h**	**13h30**	**7h30**	**4h**	**375h**	**17**	**30**		

2- Semester 2 :

Teaching units	Half-yearly hourly volume	Weekly Hourly Volume						Evaluation	
	14-16 weeks	Courses	Tutorial	Practical works	Other works	Coeff	Credits	Continuous 40%	Exam 60%
Fundamental EU									
UEF1(O/P)									
UEF11: Immune system interface - microorganisms	67h30	3h	1h30		82h30	3	6	X	X
UEF12 : Infectious microbiology	67h30	3h		1h30	82h30	3	6	X	x
UEF2(O/P)									
UEF21: Environmental and Applied Microbiology	67h30	1h30	1h30	1h30	82h30	3	6	X	X
EU methodology									
UEM1(O/P)									
UEM1: Bioinformatics and exploratory genomics	60h	1h30	1h30	1h	65h	3	5	x	X
UEM2 Control techniques of microbiology	45h	1h30	1h30		55h	2	4	x	X
EU discovery									
UED1(O/P)									
UED1 Antimicrobial agents	45h	1h30	1h30		5	2	2	X	x
Cross-disciplinary courses									
UET1 Legislation	22h30	1h30			2h30	1	1	1	1
Total Semester 1	**375h**	**13h30**	**7h30**	**4h**	**375h**	**17**	**30**		

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Teaching units	HS	V.H weekly				Coeff	Credits	Evaluation	
	14-16 weeks	Courses	Tutorial	Practical work	Other			Continuous 40%	exam 60%
Fundamental EU									
UEF1(O/P)									
UEF11: Molecular analysis of Microbial diversity	67h30	3h	1h30		82h30	3	6	X	X
UEF12: Genome regulation	67h30	3h	1h30		82h30	3	6	X	x
UEF2(O/P)									
UEF21: Microbial ecology	67h30	1h30	1h30	1h30	82h30	3	6	X	X
EU methodology									
UEM1(O/P)									
UEM11: Biochemical analysis techniques	45h	1h30	-	1h30	55h	2	4	x	X
UEM12: Molecular and medical microbiology	60h	1h30	1h30	1	65h	3	5	x	X
EU discovery									
UED1(O/P)									
UED11 Scientific English	45h	1h30	1h30		5	2	2	X	x
Cross-disciplinary courses									
UET1(O/P)									
UET11 Entrepreneurship	22h30	1h30			2h30	1	1		X
Total Semester 1	**375h**	**13h30**	**7h30**	**4h**	**375h**	**17**	**30**		

4- Semester 4 :

Field **Natural and Life Sciences Field**
Biology
Specialty **Microbiology**

In-company internship culminating in a dissertation and oral presentation.

	VHS	Coeff	Credits
Personal work	225	09	18
Internship	150	06	12
Seminars			
Other (please specify)			
Total Semester 4	375	15	30

5- Overall summary of training: (indicate the overall VH separated into courses, TD, for the 04 teaching semesters, for the different types of UE)

EU / VH	UEF	UEM	UED	UET	Total
Courses	405	135	67.5	67.5	675
TD	180	112.5	67.5	-	360
TP	67.5	67.5	-	-	135
Personal work	967.5	360	15	7.5	1350
Other (PFE internship)		150			150
Total	1620	825	150	75	2670
Credits	72	39	6	3	**120**
% in credits for each EU	60	32,5	5	2,5	100

III - Detailed program by subject

(1 detailed sheet per subject)

Subject title 1: Microbiology and health

Credits: 6

Coefficients: 3

a) Objectives of the Teaching Unit

This teaching unit is designed to train students in the most pressing topics in contemporary medical microbiology: origin and transmission of contagious diseases, pathogenesis and virulence factors, host susceptibility to pathogens, co-evolution, origin of infectious diseases, evolution, prevention and control, etc.

Recommended prior knowledge

This course requires extensive training in Microbiology, and will be open as a priority to students who have taken the "Molecular and Medical Microbiology" course.

Contents

Introduction

Chapter I - Host-Bacteria interactions

-Normal microflora (skin microflora, oral microflora, digestive microflora, stomach, small intestine, colon, urogenital microflora).

-Host immune defenses **(**non-specific defenses, anatomical barriers, biological barriers, biochemical barriers, specific defenses, antibodies, T lymphocytes and macrophages, antiphagocytic action, other resistance mechanisms).

Chapter II-Bacterial infections

-Nature of infection (general characteristics and KOCH postulates).

-Development infection (transmission, colonization and invasion).

-Pathogenicity factors (toxins, exotoxins, endotoxins, virulence, biofilms, etc.).

-Infection control (epidemic control, vaccination).

- Host-bacterial interaction.

Chapter III-Microbial infections

-Airborne diseases: bacterial diseases (Tuberculosis, Diphtheria, Legionellosis, etc.), viral diseases (Respiratory Syndromes, Influenza, etc.).

-Diseases transmitted by contact: bacterial diseases (gonorrhea, tetanus, etc.) and viral diseases (AIDS, Hepatitis B, etc.).

Water- and food-borne diseases: bacterial diseases (cholera, phoid fever, etc.), viral diseases (acute viral gastroenteritis, hepatitis A, etc.), and protozoan diseases (amoebiasis, giardiasis, etc.).

Chapter IV: Antibiotic therapy and antibiotic resistance

-Clinical and therapeutic trial (antibiotic therapy)

-Resistant pathogenic microorganisms.

-Causes of antibiotic resistance.

- Genetic support and evolution.

-Alternatives to antibiotic prescription.

Chapter V-Diagnosis and treatment of microbial infections

-Epidemiological surveys.

-Diagnostic criteria and methods (classical and molecular).

- Treatments for microbial infections (classification, mode of action, interaction, etc.).

-Current and prospective curative and preventive approaches.

Tutorial and/or practical work (20h)

TD1: Basic principles of the host-parasite
relationship TD2: Main stages in the infectious
process. TD3: Mechanisms of bacterial virulence
TD4: Different types of infectious diseases and nosocomial infections TD5:
Principles antibiotic therapy
TD6 :Mechanisms of resistance acquisition TD7
:Basic principles of epidemiology TD8 :Diagnosis
of microbial infections TD9 :Treatment of
microbial infections
TD10 :Preventive measures against infectious diseases

Personal work

Presentations or analysis of articles

Assessment: 01 2-hour exam at the end of the semester.

References *(books and handouts, , etc).* website:

http://www.master.bmc.upmc.fr/

http://www.edu.upmc.fr/sdv/microbiol/

Subject title 2: Bacterial physiology

Credits: 6

Coefficients: 3

Teaching aim *:* This unit enables students to understand the relationships between the different structures and physiological and metabolic functions of the cell; to know and understand the main mechanisms enabling bacteria to acquire and transform the different nutrients essential for their growth; and to distinguish the different types of energy metabolism existing in the bacterial world and understand how they function and are regulated.

Recommended prior knowledge: Knowledge of general bacteriology

Contents :

- Introduction: The prokaryotic cell (bacteria, structure and composition)
- Physico-chemical factors influencing bacterial growth.
- Bacterial division, time to growth and time to results.
- Dynamics of bacterial growth and implications for bacteriological diagnosis
- Molecular mechanisms of the microbial cell cycle.
- Biosynthesis and bacterial growth.
- Membrane transport and cellular communications.
- Motility and chemotaxis.
- Global regulation; differentiation.
  - ✓ Metabolism regulation: Regulation of enzyme synthesis; Regulation enzyme activity; Secondary metabolism
- Energy, environment and microbial survival

Tutorial and hands-on :

TP1: Techniques for measuring biomass and bacterial growth kinetics TP2:

Physiological tests used in bacterial identification.

TD1: Bacterial structure and composition; TD2: Microbial cell cycle; TD3: Membrane transport, and TD4: Microbial metabolism.

Assessment : Continuous assessment and exams

References

- MICROBIAL PHYSIOLOGY; Fourth Edition Albert G. Moat John W. Foster Michael P. Specto. JOHN WILEY & SONS, INC. 2002 PUBLICATION
- MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY. Carbon and nitrogen metabolism hashi Chawla. Department of Microbiology. New Delhi . 2008
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Subject title: Molecular and medical virology

Credits: 6

Coefficients: 03

Teaching objectives

The teaching offered in this unit builds on the theoretical foundations taught in the course common to all virology students: basics of molecular and medical virology. The aim of this unit is to provide the theoretical and practical training required by students wishing to undertake an internship in a research laboratory or in a sector of activity concerned with the fundamental and applied aspects of viruses of medical interest in humans.

Recommended prior knowledge: Knowledge of general bacteriology

Contents :

Introduction

I- Virus genomes

-Molecular genetics of viruses

-Virus mutations

-Genetic interactions between viruses

-Simple brain negative and positive RNA viruses

-Segmented and multipartite virus genomes

-Reverse Transcription and Transposition

-Evolution and epidemiology

II- Replication

-Replication virus overview

-Study of virus replication

-Replication cycles of some viruses

III- Expression

-Expression genetic information

gene expression in prokaryotes

- Control of lambda bacteriophage gene expression

IV- **Pathogenesis**

-Cellular mechanisms

-Immunodeficiency Virus

-Viral diseases

-Bacteriophages and human diseases

-Cellular transformation by viruses

-Viruses and cancer.

-Emergence of new viruses

-zoonoses

IV-Viral infections

-Plant virus infections

-Virus-host interactions

-Viruses and Apoptosis

-Immune responses to viral infections in animals (Natural and acquired immunity)

-Viruses evade immune responses

- -Infection chemotherapy

Tutorial

TD1: Viruses and gene therapy

TD2: Organization, replication and oncogenesis in HIV retroviruses TD3:

Organization and replication in *papilomaviruses*

TD4: Organization and replication of Epstien-Barr

TD5: Organization of the influenza genome

TD7: Transcription, translation and replication of the *Adenovirus* genome

TD8: Lentivirus: exprission, replication and leukemia

TD9: Organization of the paramyovirus genome TD10:

Chemotherapy of virus infections

Personal work

Analysis of articles genome organization other viruses

Subject heading 1: Origin, evolution and diversity of eukaryotes

Credits: 5

Coefficients: 2

Teaching objectives

This course covers the origins of eukaryotes and impact on human society, as well as their use in fundamental research.

Recommended prior knowledge: Microbiology - genetics and ecology

Contents :

I.-Origins of eukaryotes: Facts and theories

- A simple chronology of evolution
- Milestones in the history of life (earliest forms of life, first metabolisms and main stages in the development of life).
- Metabolic processes in early life
- **Notion of biological evolution**: Biological evolution refers to the transformation of primitive organisms that appeared several hundred million years ago, gradually leading to the present situation.
- **Theories:** The biological evolution of living beings is the result of two processes: the transformation of species over time, and the disappearance old species. For these reasons, theories relating to evolution are known as evolutionism or transformism. Evolution is a **fact** confirmed by countless concordant observations, and explained by **theories**.
- Experiments and theories on the formation of the earth.

II -Diversity and phylogeny of eukaryotes

- History of the classification of living organisms
- Illustrated inventory of eukaryotic diversity
- Living beings are characterized by considerable morphological and biological diversity, and inhabit all environments, both terrestrial and aquatic. The difficulties disappear if we consider that the fundamental distinction between living beings is not between plants and animals, but between two groups called prokaryotes and eukaryotes, characterized by the absence or presence of a cell nucleus.

III - Functioning a eukaryotic cell

- General characteristics of eukaryotic cells
- Organization of eukaryotic cells
- Homeostasis
- Cell anatomy and functions
- How a cell works
- Biochemical constituents
- Internal structure
- The extracellular matrix
- Reproduction: mitosis and meiosis

IV. Symbiosis and parasitism

- Defining symbioses and parasitisms
- endosymbiosis theory
- The contribution of symbiosis and parasitism to the evolution of living beings

V.-Evolution and place of eukaryotes in the biosphere

- Some major milestones in the evolution of the biosphere.
- Emerging from the waters and conquering the land.
- Terrestrial plant diversification.
- Major biological crises.

VI -The impact of eukaryotes on human society

Example of the use of eukaryotic microorganisms in fundamental research (take the example of the yeast *Saccaromyces cereviciae* and its applications in research and industry...). **Tutorial and partiques**

-1- Experiments describing the formation of the primitive earth 2-Theories defining the origin of life

3. - The emergence of multicellularity

4 - Research applications for eukaryotes

5. Impact on society

Personal work

Analysis of articles describing appearance and evolution of life and living beings, their applications in various fields.

Assessment: 01 2-hour exam at the end of the semester.

References

BIRREN, B., GREEN, E., KLAPHOZ, S., MYERS, R., ROSKANS, J. *Genome Analysis. A Laboratory Manual,* V 3, 4, Cold Spring Harbor Press, Cold Spring Harbor, New York, 19

Subject title 2: Bioreactor and biotechnology of microorganisms

Credits: 4

Coefficients:2

Teaching objectives

-Describe what the student is expected to learn about fermentation and enzymatic reaction equipment in order to better master the processes involved in manufacturing food products.

-Learn about the biotechnological applications of micro-organisms and their use in the agri-food industry.

Recommended prerequisites: Industrial and food microbiology, biochemistry, molecular biology and bacterial genetics.

Contents :

I.- Bioreactor

1- Elements of reactor theory: Continuous and batch reactors; Flow in reactors; Residence time distribution; Applications;

2- Biological reactors: Enzymatic and microbiological reactions; Method of use

3 -Homogeneous and heterogeneous reactions: Enzyme reactors and fermenters or microbiological reactors

II- Biotechnology of microorganisms

1. Biotechnology concepts
2. Biotechnological processing using micro-organisms (lactic acid bacteria, yeasts, etc.)
3. Recombinant protein production and genetically modified organisms

   - Phenotypic effect of overexpression; phenotypic effect mutated protein expression (dominant-negative)

   Producing antibodies and large quantities of proteins of economic interest (drugs and agri-food)

   -Cloning into an expression ;

   -Transfer to a host cell (bacterium, yeast, etc.) and method of transformation, infection, etc.

   -Production phase, separation, extraction and production.

4. **Production of recombinant and synthetic vaccines**

   Problems with traditional vaccines; Impact of biotechnology on vaccine development; Immunity production mechanisms; Improving vaccine efficacy; Antigen fragments used as synthetic peptides; Vaccines; DNA vaccines; Vaccines in development.

5 - Recombinant DNA technology: extraction, assay, cloning, expression and verification of gene presence.

6- Production of microbial polysaccharides and polyesters

7- Bio-fertilizer

Tutorial and practical work

3 TDs: exercises on cloning, gene transfer, methods for purifying DNA molecules and DNA, etc.

3 TD: cellulolytic micro-organisms;. pectinololytic micro-organisms

. Lignolytic microorganisms; Lactic acid bacteria involved in the fermentation of plant products

Practical work: production and purification of a protein secreted by lactic acid bacteria.

Personal work

Visit to a pharmaceutical company to produce drugs (SADAAL) or a fermented product. Students must submit their internship report.

Assessment : 2 continuous assessment tests + 01 final examination

References (Books and handouts, websites, etc.).

Laguerie P. 1991. Reactor and reaction engineering. Ed.Tec et Doc.
N.f. 2001. Biotechnologie, critères de performances des récipients : tome 4 : Bioréacteurs. Ed. Lavoisier.
Monique Larpent G. 1992. Biotechnology: principles and methods. Ed. Doin.

Subject title: Digital Ecology

Credits: 2. Coefficients:2

Teaching objectives

Understanding ecological facts digital data analysis

Recommended prior knowledge Ecology module, 2nd year SNV

Subject content :

I. Ecological data and descriptors

II. Matrices, operations and calculations

III. Association measures

IV. Abundance distributions

V. Variable transformations, regression and similarity models

VI. Ordination and grouping

Tutorial

A series of exercises on the themes studied.

Personal work

Presentation of projects based on samples chosen and studied by students themselves. Case studies

Evaluation : Written exam at the end of the semester
+ TD exam
+ Grade for personal work

References (*Books and handouts, websites, etc.).*

DAGET, 1987. Mathematical models in ecology. Publisher: Masson. Collection: Collection d'Ecologie. 172p. ISBN-10: 2225440557

LEGENDRE L., 2007. Ecologie numérique t1. le traitement multiple des données écologiques. Publisher: Masson. Collection: Ecologie. ISBN-10: 2225801320

LEGENDRE L., 2000. ECOLOGIE NUMERIQUE T.1. Publisher: Masson. Collection: Collection d'écologie. ISBN-10: 2225624143.

Subject title: Scientific communication

Credits: 1

Coefficients: 1

Teaching aim: Master the methodology of experimental research in biology. Know how to write a scientific article, prepare a presentation, a thesis or a dissertation.

Contents

1. General information on the scientific approach
2. Pre-scientific methods
3. Objective of the scientific method
4. The basic premise of the scientific approach
5. The main stages in the scientific process
6. Good and bad research problems
7. Analysis of scientific texts
8. Demonstrating a problem
9. Defending a point of view on an issue.
10. Literature review, databases
11. Setting up the protocol
12. Ethics: key points
13. Example of a scientific approach (setting up the concept under study, causal relationships, determinations, statistics).
14. Dissemination of results (scientific publication, oral communication, dissertation)

Personal work :

Oral and poster presentations on examples of scientific topics

Subject title: Interface between the immune system, microorganisms and the environment
Credits: 6

Coefficients: 3

Objectives of the Teaching Unit

This teaching unit at the interface between two disciplines, immunology and microbiology, aims to provide students with theoretical training on the interactions/relationships existing between pathogenic microorganisms for animal and plant cells and the immune system as a whole.

- Anti-infectious immunity

1- Recognition of microorganisms by immune system molecules and cells :

- Innate recognition (epithelial barrier, innate immunity receptors, phagocytes, NK cells). -Acquired antigen recognition (lymphocytes, TCR and antibodies).

2- Effector mechanisms of defense against infectious agents :

-Interferons, the proteins of the acute phase

Humoral-mediated immunity (elimination of toxins and extracellular microbes): opsonization and phagocytosis, ADCC).

Cell-mediated immunity (eradication of intracellular microbes): CD4+ T lymphocytes, CD8+ T lymphocytes, immune memory.

3- Molecular mechanisms of microbial pathogenicity and escape from the immune system :

-Bacteria Bacterial infection and immunodepression (*Salmonella and Shigella*, viruses).

- CMV escape from the immune system (subversion)

-Hepatitis C virus and interferon escape.

4- Molecular mechanisms of the pathogenicity of a particular parasite.

5- Molecular mechanisms of plant microorganism pathogenicity-plant defenses:- Introduction: presentation of the different symbiosis-parasitism interactions (pathogenicity, plant defenses), example a plant-fungus interaction with *Botrytis cinerea*, and a plant-bacteria interaction with *Agrobacterium*, tumor development.

- Vaccination

- The point of view immunologists -Malaria vaccine

- Immunological synapse and virus. The immunological synapse.

• Use of the synapse by viruses.

Tutorial

• TD1: Innate and acquired recognition of microorganisms by immune system molecules and cells.

• TD2: Defense mechanisms against infectious agents

• TD3: Pathogenicity of rift valley fever virus

• TD4: Viruses and inflammation

• TD5: Manufacture of chimeric VLPs (HCV-coronavirus/HCV-lentivirus), tools for vaccination.

• TD6: Immune memory. Vaccination: the point of view of immunologists.

• TD7: GMOs, obtaining transgenic plants resistant to a microorganism.

Personal work

Analysis of articles on the subjects of defense mechanisms and host-pathogen interaction.

Evaluation: continuous and 1 exam at the end of the semester.

References

http://www.master.bmc.upmc.fr/ http://www.edu.upmc.fr/sdv/immuno/index.php

Subject title 2: Infectious microbiology

Credits: 6

Coefficients :03

Teaching objectives

This course provides students with the essential conceptual foundations for understanding infectious diseases, combining fundamental, pathophysiological, epidemiological and clinical aspects.

Recommended prior knowledge. Basic knowledge of microbiology.

Contents :

- Respiratory infections: *Mycobacterium tuberculosis*, *Legionella pneumophila*,*Yersinia pestis*
- Gastrointestinal infections: *Vibrio cholera, Salmonella, Helicobacter pylori, Clostridium difficile*
- Urinary and sexual infections: Gonorrhea, Syphilis
- Eye and skin infections*: Streptococcus, Staphyloccoccus*
- Cardiovascular and nervous system infections
- Zoonotic infections
- Nosocomial infections
- Viral infections
- Parasitic infections: *Trypanosoma* spp., *Leishmania* spp., *Trichomonas vaginalis*, *Giardia intestinalis*, *Entamobea histolytica*, *Plasmodium* spp., *Toxoplasma gondii*, *Cryptosporidium parvum*)
- Diagnosis of infectious diseases
- Principles *infectious* disease epidemiology

Practical work

5TP: Collection, enrichment, inoculation on selective media, purification and phenotypic identification of some human pathogenic bacteria.

Personal work :

10 to 15-day internship in a hospital or medical laboratory, followed by an internship report.

Assessment : Continuous assessment and examination

References

- Alcamo's Fundamentals of Microbiology, 9th Ed, Pommerville, J.C., Jones and Bartlett, Publ, 2006.
- http://www.cdc.gov/mmwr/

Subject title: **Microbiology applied to environment**

EU Title : UEF21 Credits: 5 Coefficients: 2

Teaching objectives: This teaching unit focuses on multidisciplinary areas of research in applied microbiology. It enables students to learn how to use microorganisms, for their products, and for their ability to transform and degrade certain substances with the aim of obtaining useful compounds or cleaning up the environment. The practical course Applied Microbiology enables students to familiarize themselves with techniques such as the genetics of industrially important microorganisms, standards of good practice in bioindustries, food microbiology, environmental microbiology, fermentation or the biosynthesis of natural products.

Recommended prerequisites: Basic knowledge of microbiology, genetics, biotechnology and biochemistry.

Contents

- Microbiology's place in the natural sciences
- Microbial diversity and function in *greenhouses*
- Technological uses of marine bacteria
- Microbial transformation under stressful environmental conditions
- Microbial biotechnology for the environment
- Bioremediation
- Bioconservation (usefulness of lactic acid bacteria and their secondary metabolites)
- Wastewater treatment (different types of bacterial beds used water purification)
- Treatment of polluted soils (role of telluric bacteria in the biodegradation of heavy metals and hydrocarbons)
- Functionalities and activities of microorganisms of environmental interest
- Fundamental and economic aspects of pathogen control: antimicrobial and antibiofilm activity.
- Effects of genetically modified plants on the distribution and abundance of soil microorganisms.

Tutorial and practical work :

TD: Presentation scientific articles on major environmental issues.

TP1: Sea outing, sampling techniques

TP2: trip, sampling techniques

TP3: Measure respiration (O2 chemical assay) and bacterial production (spectrophotometry).

TP4: Purification assay of an α-amylase enzyme from *Sacharomyces cerevisiae* yeast

Personal work: Analysis and presentation of the scientific articles proposed to clarify their scientific views on the debates in question.

Assessment : This teaching is assessed a semester exam, the presentation of a scientific article and a report on the practical work carried out.

Subject title: **Bioinformatics and genomics of microorganisms**

EU Title : UEM11 Credits: 5 Coefficients: 2

Teaching objectives

Introduce students to the concepts, tools and techniques of genomics and bioinformatics, and familiarize them with the main databases and modern methods for analyzing the evolution and functioning of genomes.

Recommended prior knowledge

Basic knowledge of molecular biology.

Contents :

-Genome sequencing: Sequencing methods and genome assembly

-Biological databases

-Sequence bank similarity search

-Multiple alignments: Pattern matching and phylogeny

-Genome annotation: Structural and functional annotation

-Comparative genomics :

Syntenies, Genomic rearrangements, Horizontal transfers, Gene duplications and losses, Orthologous and paralogous genes, Polymorphisms.

-Genome visualization tools

-Metagenomics

-Functional genomics: transcriptomics and proteomics

-Metabolomics

-Nutrigenomics, Pharmacogenomics

Practical work

1- Search for bibliography in the *PubMed* database

2- Sequence search in 3-Genome annotation

Structural annotation (gene prediction) Functional

annotation

Homology search with *BLAST*

Prediction of cellular protein localization (*PSORT* and *TMHMM*) 4-Multiple sequence alignment (*ClustalW*)

5- Comparative genomics

6- Genome browsers

7- Analysis of *KEGG* metabolic pathways

8- Protein secondary structure prediction

Personal work :
Analysis and presentation of articles relating to the proposed themes.

Assessment : Continuous assessment and exams

References (Books and handouts, websites, etc.).

- Bernot, Alain - Analyse de génomes, transcriptomes, et protéomes - Dunod, (2001).
- Krane, D.E. and Raymer, M.L. (2003) Fundamental concepts of bioinformatics. Benjamin Cummings (ISBN 0-8053-4633-3)

Subject title: Microbiology control techniques

Credits: 4

Coefficients:2

Teaching objectives

The objectives of this subject are to understand all the techniques used to control microbial activity (microbiological examination of samples and biological fluids, quality control, antibiotic therapy, etc.), and to use and improve their properties when they are beneficial (yeasts, yoghurt, antibiotics, vaccines, etc.).

Recommended prior knowledge: General microbiology, biochemistry.

Contents :

I- Methods for quantifying contaminant populations

-Enumeration after culture (dilution, mass plating and surface plating techniques).

-Direct cell counting using a microscope (cryometry and cell counting).

II- Microbiological control as part of the quality approach

1. Control categories in the food industry.
2. Microbiological control levels in manufacturing. 3-

Microbiological quality control laboratories

4. Methods used for microbiological analysis
5. Food product inspection stages.

III -Search and identification of microorganisms responsible for food poisoning

-Microorganisms responsible for collective food poisoning.

-Methods used to search for and identify enteropathogenic bacteria.

-Research and identification of the main microorganisms and toxins responsible for TIAC.

IV - Water microbiology control

-Water sampling; Preparation of culture media; Dilution coliform MPN determination; Testing for total coliforms, thermotolerant coliforms; Sterilization; Cyanobacteria and cyanotoxin cell .

-Determination of Giardia sp and Cryptospridium sp in water by filtration, immunomagnetic separation and immunofluorescence microscopy.

V.-Environmental microbiological controls in healthcare establishments air, water, surfaces

-Environmental infectious risks;-Indications and implementation of microbiological environmental controls;-Ongoing monitoring and spot checks

-Regulatory, recommendation or quality approach ;-Quality improvement

-Limits of microbiological environmental controls.

Practical work

TP1: Microbiological control of food products: yoghurts, meats, juices, beverages, TP2: Denornbrernent of *E. coli* in soft cheeses made with raw milk and milked milk. TP3 - Sterility control of fruit juices by ATP metrology

TP4 - Microbiological testing mineral water

TP5 - Enumeration of yeasts and moulds in spices and herbs

Personal work :

Vite or internship (10 days) in a quality control laboratory, followed by an internship report.

References:

Bonnefoy Caroline, Guillet Françoise, Leyral Guy (2002). Microbiology and quality in the food industry. Doin, Français, pp 245.

http://www.qualiteperformance.org/c

Subject title: Antimicrobial agents

Credits: 2

Coefficients: 2

Teaching aim:This subject covers the different types of antimicrobial agents (antibiotics, antivirals, antifungals, antiparasitics), their mechanisms of action and the resistance mechanisms developed by microorganisms.

Recommended prior knowledge: microbiology and bacterial physiology.

Contents :

1- General principles: Definitions, measurement antimicrobial activity.

2- Physical agents: heat, tyndallization, pasteurization, filtration, radiation (UV and ionization).

3- Chemical agents: -General principles, action on growth Selective toxicity.

4- Disinfectants and antiseptics: Definitions, chemical nature of antiseptics (alcohols, etc.) and disinfectants (aldehydes, detergents, heavy metals), therapeutic use in cleaning operations for bioproduct preservation, spectrum activity and mode of .

5- Antibiotics: General information, classification of antibiotic substances (b-lactams, aminosides, macrolides, tetracyclines, chloramphenicol, sulfonamides) and anti-metabolites. Mechanism of action: Action on wall, membrane, protein synthesis, acid synthesis, etc.

6- Antifungals, antivirals, antiparasites: definition, classification, mode of . 6- Resistance of microorganisms to antimicrobial agents.

Resistance to physical agents, antibiotics, antifungals, antivirals and antiparasites, resistance mechanisms and genetic support, and evolution of resistance.

7- Study of interaction of antimicrobial agents.

8- Use of antimicrobial agents food, agriculture and animal production.

Tutorial

6 TD: Effect of antimicrobial agents (antibiotics, antifungals, antimetabolites, antivirals) on the growth of pathogenic microorganisms and the synergistic effect

2TD: Synergetic effect of antibiotics and antifungals on microbial growth. 1 TD: Analysis of genetic elements of antibiotic resistance mechanisms.

Personal work

Presentation and analysis of articles on new antimicrobial agents and their cellular targets.

Assessment : Continuous assessment and exams

References

Bobbarala V (2012). Antimicrobial agents, Janeza Trdine, Rijeka, Croatia, p, 413.

Bryskier A (2005).Antimicrobial Agents: Antibacterial and antifungal, Washington, p, 1426.

Subject title: Legislation, regulations and microbiological standards relating to different media.

Credits: 1

Coefficients: 1

Teaching aim: To introduce students to the main national and international regulations and legislation governing quality control in biological analysis laboratories, as well as microbiological criteria and standards for different environments (food, drugs, cosmetics, agriculture and the environment: water, air and soil).

Prerequisites: microbiological analysis, microbial infections, microbial systematics, asepsis.

Contents :

1 - Introduction

2 - Legislation according to microbiological fields of application: (food, agriculture and environment: water, air and soil).

- Overview of surveillance authorities: External services - Border inspection -. Mixed brigades - Status of control bodies.
- Action specifics
- Professional organizations
- Technical centers
- Presentation of government bodies involved in these areas (Department of Trade, Department of the Environment, Chambers of Agriculture, Research Centers, etc.).
- Documentary resources: methods and standards.
  - Official journals, regulatory magazines, websites, international organizations, etc. 3 -

Legislation in analytical laboratories:

- Laboratory advice
- working in the laboratory: working hours, vacations, absences, ethics charter.

On-call and hardship work.

- Distribution of analysis results: Confidentiality, publication.
- Hygiene and safety: handling germs and hazardous products.
- Training and updating of methods.
- Use of IT resources.
- Laboratory accreditation: conditions and requirements for their operation.
- Bodies involved in control and inspection:
  * Certification and accreditation bodies

* Private analysis and control laboratories.

4 - the Code of Criminal Procedure and the Penal

Code. Evaluation method: Continuous: 2 Exam: 1

Reference :

- JORA: Journal Officiel de la République Algérienne.
- Codex alimentarus. Pharmacopoeias.
- National and international standards.

Subject title: Molecular analysis of microbial diversity

Credits: 6

Coefficients: 03

Teaching objectives

This subject enables students to understand and interpret the results obtained from the different types of molecular techniques used to identify taxonomic levels and analyze microbial diversity. It also covers the applications of molecular techniques in various fields (taxonomy, biotechnology, medicine, ecology, etc.).

Recommended prerequisites: prokaryotic systematics, bioinformatics, molecular biology, microbial genetics.

Contents :

I- Percentage guanine+ cytosine (%G+C) microbial diversity analysis II.-Molecular techniques based on gene analysis

-PCR, 16S rDNA and phylogenetic analyses

-PCR of low molecular weight RNA (5S rRNA and tRNA).

III - PCR-based typing methods

-Restriction fragment length polymorphisms (PCR-RFLP).

-Amplified fragment length polymorphism (AFLP**).**

-Polymerase chain reaction using arbitrary primers (AP-PCR) .

-Polymerase chain reaction of repetitive elements (REP-PCR).

-DNA by random amplification (RAPD).

-MLSA (multi locus sequence analysis).

V.-Molecular techniques based on hybridization

-Genomic DNA/DNA hybridization.

-Nucleic acid microarray analysis.

VI - Molecular techniques based on protein profile analysis

Genome analysis by pulsed-field electrophoresis (PFGE).

-SDS-PAGE of total cellular proteins.

-MALDI-TOF mass spectrometry.

-Denaturing gradient gel electrophoresis (DGGE) and other techniques such as TGGE, TTGE, MADGE.

VI.I- Analysis of cellular constituents

Cellular fatty acid analysis (FAME)

Variations in the electrophoretic mobility of certain bacterial enzymes (MLEE)

Tutorial

-Sequence analysis 16S DNA from bacteria (filamentous bacteria isolated from soil, milk, water, human pathogenic Gram+ and Gram- , etc.).

-Molecular analysis of methanogenic populations, halophilic bacterial populations, hyperthermophilic populations, digestive tract microorganisms, marine microorganisms, oil well microbial populations, rhizospheric bacteria, biodiversity of nitrifying bacteria, etc.

Personal work

Analysis of articles on use of different techniques studied for bacterial diversity in various fields (medical, agronomic, food, etc.).

References

www.mon.univ-
montp2.fr/claroline/backends/download.php?urlwww.irsn.fr/EN/Research/..
.post.../2013-These-Theodorakopoulos.pd w ww.med.univ-
montp1.fr/.../Diversite_genetique_variation_antigeniqu

Master title : Microbiology

Semester*:* 3
EU Title : UEF12 :

Subject title: Genome regulation
Credits: 6
Coefficients :03

Teaching aim: This course students with a sound knowledge of the main mechanisms regulating gene expression.

Recommended prior knowledge

Good level in molecular biology and fundamental microbiology.

Contents :

- Regulation by regulatory proteins: Activation vs. Repression
-Control of the lactose operon and control of tryptophan operon
- Catabolic repression.
- Global regulation by *Quorum sensing.*
- Global system control has two components.
- Global regulation by sigma factors (sporulation, heat shock, stationary phase).
- Regulation of the lytic or lysogenic cycle in phage lambda.
- SOS response.
- Regulation by riboswitches.
- Regulation by regulatory RNAs.
- Molecular techniques for studying gene expression (Northern blot, S1 mapping, primer extension, RT-PCR, EMSA,....). **Tutorial**

1- Exercises on the regulation of the lactose, tryptophan and arabinose operon
Analysis of mutants and partial diploids
2- Quorum sensing
3- Systems has two components
4- Sigma factors
5- Regulation of the lysogenic and lytic cycle of phage lambda

Personal work :

Analysis of articles on gene regulation in bacteria.

Assessment : Continuous assessment and exams

References

Clauser E., (2001). Biochimie génétique, biologie moléculaire médecine, pharmacie. Edition Masson.
- Clauser E., Couchon S., (2005). Genetic biochemistry, molecular biology. EditionMasson.
- Lodish H. et al. (2005). Molecular biology of the cell. 3rd edition, De Boeck, 1096p.

Subject title: Microbial ecology

Credits: 6

Coefficients: 03

Teaching objectives

This teaching unit introduces students to the essential role played by microorganisms in the functioning of ecosystems, and in particular in the recycling of elements. It presents the different interactions within this microbial community, the environmental factors influencing its composition and activity, and the role of microorganisms in biocorrosion, biofouling and biodecontamination phenomena, through general lectures.

Recommended prerequisites: Basic knowledge of microbiology, genetics and biochemistry.

Subject content: Microbial ecology

- Microbial biodiversity in an ecosystem.
- Interactions between micro-organisms.
- Microbial food webs in natural environments.
- The role of micro-organisms in the ecosystem.
- Host-microorganism interactions (symbiosis, commensalism, parasitism, etc.).
- Microbial biodiversity in the cycles of carbon, nitrogen, sulfur, phosphate, etc.

Microbial ecology in a food matrix: endogenous and exogenous sources of contamination and factors influencing microbial diversity and abundance in foodstuffs

- Biodepollution: natural decontamination of environments using micro-organisms, and use of micro-organisms in the treatment of wastewater or polluted soil.
- PGPRs ;- Importance of microbial biodiversity in food processing and fermentation.

Tutorial

TD1-4: Microbes and the carbon, nitrogen, sulfur and phosphorus cycle; **TD5:** Microbes and the water cycle; **TD6:** Microbes and the oxygen cycle; **TD7:** Microbes and the hydrogen cycle; **TD8:** Microbes and the heavy metal cycle.

Personal work: In the form of a presentation on the tutorial themes presented and analyzed in the form of a divergent and approved scientific debate on the subject.

Assessment : continuous assessment+ personal work and semester exam.

References

http://www.master.bmc.upmc.fr/
http://www.edu.upmc.fr/sdv/microbiol/

Subject title: Molecular and medical microbiology

Teaching objectives

The "Molecular and Medical Bacteriology" teaching is organized by scientific and medical teachers, researchers and specialists in medical bacteriology. The program is designed to train students from medical and scientific backgrounds in the most fundamental issues of medical bacteriology.

Recommended prior knowledge

This course requires extensive training in Microbiology, and will be open as a priority to students who have completed the "Molecular and Medical Microbiology" course.

Contents

Introduction

Chapter I: Molecular bacteriology

1- Natural genetic exchange

2- Structure and dynamics of prokaryotic genomes

3- Aspects of regulation in prokaryotes

4- Bacterial communication

5- **Chapter II: Medical bacteriology**

6- 1- Bacteriological diagnosis

2-Physiopathology of bacterial infections 3-

Cellular microbiology

4-Mode of action and antibiotic resistance mechanisms.

5-Genetic elements and antibiotic resistance.

Tutorial and/or practical work

TD1: Man and his microbial flora.

TD2: Factors involved in natural exchanges

TD3: Notion of horizontal transfers

TD4: Microbial genetics

TD5: Mechanisms of resistance acquisition

TD6: Antibiotic by prokaryotes TD7: Anti-infective

agents

TD8: Host-bacteria interaction

TD9: Biofilms
TD10: Medical bacteriology techniques: classical and molecular.

Personal work: Analysis of articles or presentations

Assessment: 01 2-hour exam at the end of the semester.

References *(books and handouts, , etc.).* website:
http://www.master.bmc.upmc.fr/ http://www.edu.upmc.fr/sdv/microbiol/

Subject title: Chemical analysis techniques

Teaching objectives

Knowledge of basic biochemistry techniques for different types of equipment.

Recommended prerequisites Biochemistry module, 2nd year SNV

Contents :

CHAPTER I. Spectral methods

CHAPTER II. Fractionation methods

CHAPTER III. Marking methods

CHAPTER IV. Electron microscopy

Practical work

4 practical exercises: spectrophotometer, TLC, extraction and separation of molecules, etc.

Personal work.
Analysis of articles other purification methods and identification of chemical and peptide molecules of pharmaceutical interest.

Evaluation : TP exam ++Grading of personal work and written coursework at the end of the semester

References

AUDIGIE C., 1998. Principles of biochemical analysis methods. Publisher: Doin; Edition: Nelle éd. Collection: Biosciences et Techniques. 207p.

Master title : Microbiology

Semester*:* 3

EU Title : UED1

Subject title: Scientific English

Credits: 2

Coefficients:2

Teaching objectives

Develop communication skills (oral and written) and understanding English in a professional scientific context.

Recommended prior knowledge (*brief description of the knowledge required to follow this course - Maximum 2 lines).*

Contents :

-Take part in a debate.

Present a topic in a 15-minute presentation.

-Write a report.

- Mastery of basic grammar.

- Sentence structure and word order.

- scientific and technical lexicon.

Personal work :

Study a theme chosen by the student. The student will be responsible for researching and finding the bibliography illustrating the theme. The study culminates in a report and oral presentation in English.

Assessment : Continuous assessment and examination

References *(Books and handouts, websites, etc.).*

EU Title : UET1 :

Subject title: Entrepreneurship

Credits: 1

Coefficients: 1

Teaching objectives

Students learn about the professional environment in a company and prepare their integration into it.

Recommended prior knowledge

No pre-requisites are required to follow this course.

Contents :

- Company types
- Integrating the company into the production system.
- Power and decision-making in the company.
- Information in the company.
- Corporate decision-making.
- Business and finance

    Financial choices

    Financing needs and solutions.

    The company's financial equilibrium (introduction to accounting: reading accounts, income statements and balance sheets)
- Fiscal policy and monetary policy.
- Financing methods

Personal work

Presentation of self-selected projects.

Assessment : Continuous assessment and examination