UCLouvain

lsinc1331

2022

Molecular biology

5.00 credits	30.0 h + 30.0 h	Q1

This learning unit is not open to incoming exchange students!

Language :	French
Place of the course	Charleroi
Prerequisites	The prerequisites are: • In genetics (genetics and biotechnology): classical genetics, notion of genetic linkage, chromosomal theory, mitosis and meiosis, gene expression (transcription and translation with their molecular mechanism), DNA repair (everything except repair of double-strand breaks) • In biostat (proba and stat): concept of relative frequency, mean and standard deviation, probabilities and independent events, confidence interval at the mean • In biochemistry (chemistry of life): structure of proteins, effects of solvents, enzymatic catalysis • In (general and) organic chemistry: acids and bases, nucleophilic/electrophilic attacks and stereochemistry • In general biology: general structure of cells (prokaryotes and eukaryotes, evolution, molecular evolution, trophic, symbiotic and parasitic interactions *The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	• The plasticity of genetic information • Genetic engineering: molecular biology, transgenesis and genome sequencing • Genetic logic and genetic interactions • Study of polymorphism for the discovery of associations between genotype and phenotype
Learning outcomes	**At the end of this learning unit, the student is able to :** 1) Mastering molecular processes that stimulate genomic plasticity at the generational scale on the one hand and evolutionary on the other hand 2) Understand the tools of molecular biology and their limits 3) Understand the generation of large DNA sequences and their constraints 4) Integrate genetic logic and concepts of genetic interactions 5) Understand the logic of genetic association from genomic data
Evaluation methods	The assessment will be in the form of an oral exam, as long as the number of students is compatible with this type of assessment. The exam begins with a period of 45 to 60 minutes during which the student gathers these ideas and draws diagrams that can help him then present orally (about 15 minutes) an answer to the questions asked. The discussion is an opportunity to cover topics not covered by the questions initially asked. The purpose of assessment is of course to assess the integration of learning outcomes.
Teaching methods	Each chapter is the subject of one or more successive videos. The videos are posted online at the start of the course. The student watches these videos at a time when he/she is receptive, trying to understand the complex mechanisms presented in the course. At regular intervals, question-and-answer sessions, each centered on one or more chapters, are held face-to-face, in a room equipped with a separate whiteboard and video projector. Q&A sessions are not mandatory for the student. At each question-and-answer session, a first part consists of a discussion by group of 4-5 students, first on questions that seem simple, typically vocabulary words or details of mechanisms. The larger questions and unresolved details in the first part are the subject of questions posed directly to the teacher in the second part, where the whole group is brought together.
Content	**Introduction** Introductory chapter reviewing the bases acquired in previous years **Chapter 1 – DNA Transactions** 1.1. Homologous recombination: 1.1.1. The original Holiday model 1.1.2. Double strand break repair 1.2. Gene conversion 1.3. Site-specific recombination

1.3.1. Mechanism of serine recombinases
1.3.2. Mechanism of tyrosine recombinases
1.3.3. Recombinase-dependent phase variation
1.3.4. Resolution of chromosome dimers by site-specific recombination
1.4. transposition
1.4.1. DNA transposons
1.4.1.1. Insertion sequences and evolutionary origin of transposons
1.4.1.2. Conservative transposition
1.4.1.3. Replicative transposition
1.4.2. The retrotransposons
1.4.2.1. Replication of retroviruses and retrotransposons
1.4.2.2. Back transpose to poly-A
1.4.2.3. Origin of retropseudogenes
1.4.3. Domesticated transposition: V(D)J recombination
1.5. Interspecific DNA transfers
1.5.1. Conjugative Plasmids
1.5.2. ICEs
1.5.3. Bacteriophages
1.5.3.1. The M13 phage
1.5.3.2. The l-phage
1.5.3.3. Generalized transduction
1.5.4. Horizontal transfer and antibiotic resistance
1.6. Defense mechanisms against genetic invaders
1.6.1. Prokaryotes
1.6.2. eukaryotes

Chapter 2 – Introduction to Genetic Engineering

2.1. E. coli bacteria
2.2. Laboratory yeasts
2.3. Plasmids
2.3.1. Origins of replication: diversity and molecular mechanism
2.3.2. Mechanisms of plasmid incompatibility
2.3.3. Mobilizable plasmids
2.3.4. E. coli – yeast shuttle plasmids
2.4. Selection markers
2.5. counter-selection markers
2.6. Manipulation of bacteriophage M13
2.7. Phagemids
2.8. Restriction and ligation enzymes
2.9. Household Vectors
2.10. Bacterial transformation
2.11. The preparation of plasmid DNA
2.12. Agarose gel electrophoresis
2.13. PCR
2.14. Quantitative PCR

Chapter 3 – Recombinant Plasmids

3.1. Identification of clones carrying recombinant plasmids
3.1.1. Diagnostic restriction
3.1.2. PCR screening
3.1.3. a-complementation
3.1.4. The disruption of ccdB
3.2. Modifying enzymes
3.2.1. Klenow's DNA polymerase
3.2.2. Alkaline phosphatase
3.2.3. reverse transcriptase
3.3. Cloning of PCR products
3.3.1. ligation
3.3.2. Repair by a viral DNA polymerase
3.3.3. Replacement of PCR products with gBlocks
3.4. Overproduction of recombinant proteins

Reference book :

« Molecular Biology of the Gene" (Watson et al.) Pearson Eds. (2014), 7th Edition

https://www.pearson.com/us/higher-education/product/Watson-Molecular-Biology-of-the-Gene-7th-Edition/9780321762436.html

Faculty or entity in charge	SINC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Computer Science	SINC1BA	5	LSINC1231 AND LSINC1211	🔍