



COURSE OUTLINE





COURSE GENERAL INFORMATION

1	Course Title & Course Code	Molecular Biology: BIOL 021
2	Credit (Contact hour)	3 (2+1+0)
3	Title(s) of program(s) within which the subject is taught.	Preparatory Program
4	Level/year at which the course is offered:	2 nd Semester/ Preparatory Year
5	Prerequisite courses (if any)	
6	Co-requisite courses (if any)	None
7	Name of faculty member responsible for the course.	➤ Prof. Nasr Eldin Elwali
8	Name of faculty member teaching the course	➤ Prof. Nasr Eldin Elwali ➤ Prof. Salahuddin I Khan ➤ Dr. Arezki Azzi

KNO WLEDGE

SUMMARY DESCRIPTION OF THE KNOWLEDGE TO BE ACQUIRED

By the end of this course the student should be able to:

1. **Describe the structure of eukaryotic and prokaryotic cell**
2. Understand the mechanism of DNA replication, repair, transcription and translation in prokaryotes and eukaryotes
3. Illustrate chromosome structure and gene complexity
4. Describe the cellular machinery involved in the manufacture of proteins and its distribution
5. Understand the basis of genetic inheritance
6. Understand the basis of genetic mutation
7. Describe the mechanism of protein synthesis in eukaryotes
8. Describe the molecular biology techniques used for screening and diagnostic purposes
9. Describe the structure of the cell membranes and majors constituents
10. Understand the function of major classes of transport proteins located in cell membrane with as an example: ATP-powered pumps
11. Understand the role of signal transduction pathways with an example of G-protein coupled receptors (GPCR) related pathway.



TEACHING STRATEGIES TO BE USED TO DEVELOP THAT KNOWLEDGE

In this course the following teaching strategies will be utilized:

- Interactive Lectures
- Use of Animations
- Tutorial sessions
- Student self-directed learning from suggested textbook.

METHODS OF ASSESSMENT OF KNOWLEDGE ACQUIRED

In this course the performance will be assessed according to the following:

In this course the performance will be assessed according to the following methodologies:

- Quizzes
- Exams

Parameters	Score
Quiz 1	10 %
Mid-term	25 %
Quiz 2	10 %
Tutorials	15 %
Final exam	40 %
Total	100 %

LEARNING RESOURCES



COURSE DESCRIPTION

This comprehensive course is developed to introduce a foundation for the principles of molecular cell biology and genetics to preparatory year medical students. The student will first review the structure of eukaryotic and prokaryotic cell. The mechanism of DNA replication, translation and protein synthesis is explained.

The nature of DNA and the genetic code is subsequently described highlighting its significance regarding the synthesis of specific protein structures necessary for cellular function. The processes of DNA repair and gene regulation are explored. Subsequently the concept of gene mutation is introduced and how this, through production of aberrant protein structures, can lead cellular and genetic disorders.

Patterns and mechanisms of inheritance are introduced and their relation to variability in protein structures is explored.

The role of protein receptor and their relation to signal transduction pathway will be exposed with the study of G-coupled protein receptor activation and protein tyrosine kinase.

Techniques utilised in molecular biology are discussed in addition to methods of screening for several genetic disorders.



COURSE TOPICS

The course includes the following topics:

1. General concepts in molecular biology

- 1.1. Description of eukaryotic and prokaryotic cell
- 1.2. Important cellular structures in gene expression
- 1.3. An overview of the processes involved in gene expression
- 1.4. Apoptosis

2. Intracellular signalling

- 2.1. Types of chemical messenger
- 2.2. Intracellular signalling and signal transduction
- 2.3. Intracellular receptors
- 2.4. Second messengers

3. The organisation of DNA in the cell

- 3.1. The organisation of DNA in the nucleus
- 3.2. The general structure of chromatin and chromosomes; the human genome, chromosome labelling and loci

4. Transcription and RNA

- 4.1. Important structures and key components in transcription
- 4.2. An overview of the processes involved in transcription of DNA
- 4.3. RNA processing; exons, introns and micro RNAs

5. The ribosome and translation

- 5.1. Important structures and key components in translation
- 5.2. The process of translation
- 5.3. Signal recognition particles and transport of propeptides

6. Peptide processing and sorting

- 6.1. Signal recognition particles
- 6.2. Protein folding and molecular chaperone
- 6.3. Processing and sorting of proteins in the endoplasmic reticulum and Golgi apparatus

7. Gene regulation

- 7.1. The processes controlling expression of genes in prokaryotes
- 7.2. The processes controlling expression of genes in eukaryotes
- 7.3. The relation of gene expression with cell differentiation



7.4. Oncogenes and tumor suppressor genes

8. Molecular mechanisms in cell division

- 8.1. Important structures and key components in DNA synthesis
- 8.2. DNA polymerases and the process of DNA replication
- 8.3. Proof reading and repair

9. Genetic mutation

- 9.1. Mechanisms of gene mutation
- 9.2. Causes of mutation
- 9.3. Implications of genetic mutation

10. Genetics and hereditary factors

- 10.1. Mendelian and classical genetics
- 10.2. The molecular basis of hereditary
- 10.3. Complex traits, genetic linkage, crossing over and recombination
- 10.4. The functional basis of genetic variation; variable protein structure and function
- 10.5. Epigenetics

11. Protein Receptors and signal transduction pathways

- 11.1. G protein couples protein receptor activation by glucagon
- 11.2. Protein tyrosine kinase activation by insulin.

12. An introduction to the basis of molecular techniques

- 12.1. Key components, structures and principles underlying molecular techniques
- 12.2. Restriction enzymes.
- 12.3. Principles of cloning and it applications.

13. An introduction to molecular techniques and their uses

- 13.1. Amplification of DNA
- 13.2. General concepts: site directed mutagenesis, microarrays, and gene therapy



LEARNING RESOURCES

REQUIRED TEXT:

Lippincott's Illustrated Reviews: Cell and Molecular Biology by Nalini Chandar and Susan Viselli

Lippincott's Illustrated Reviews: Biochemistry 5th Edition by Richard Harvey and Denise Ferrier

RECOMMENDED TEXT(S)

1. Cell and Molecular biology 5th edition (2008) – Gerald Karp- John Wiley and Sons

WEEKLY CONTACT HOURS SCHEDULE

WEEKS	LECTURE TOPICS	INSTRUCRORS
W1 <i>25/01/2015</i>	<ul style="list-style-type: none"> • General concepts in molecular biology • Description of eukaryotic and prokaryotic cell • Important cellular structures • Passive and active transport across membranes • Apoptosis 	Prof Nasr Eldin Elwali
W2 <i>01/02/2015</i>	<ul style="list-style-type: none"> • Intracellular signalling • Types of chemical messenger • Intracellular signalling and signal transduction • Cell-surface and intracellular receptors • Second messengers 	Prof Nasr Eldin Elwali
W3 <i>05/02</i>	<p>The organisation of DNA in the cell</p> <ul style="list-style-type: none"> • The organisation of DNA in the nucleus • The general structure of chromatin and chromosomes; the human genome, chromosome labelling and loci 	Prof Nasr Eldin Elwali
W3 <i>8/02/2015</i>	Quiz 1	
W4 <i>15/02/2015</i>	<p>Transcription and RNA</p> <ul style="list-style-type: none"> • Important structures and key components in transcription • An overview of the processes involved in transcription of DNA • RNA processing: exons, introns, micro RNAs, LincRNA 	Prof. Salahuddin Khan



W5 <i>22/02/2015</i>	The ribosome and translation: Important structures and key components in translation The process of translation Signal recognition particles and transport of propeptides	Prof. Salahuddin Khan
W6 <i>01/03/2015</i>	Peptide processing and sorting <ul style="list-style-type: none"> • Signal recognition particles • Protein folding and molecular chaperone • Processing and sorting of proteins in the endoplasmic reticulum and Golgi apparatus 	Dr. Azzi
W7 <i>08/03/2015</i>	Molecular mechanisms in cell division <ul style="list-style-type: none"> • Important structures and key components in DNA synthesis • DNA polymerases and the process of DNA replication • Proof reading and repair 	Prof Nasr Eldin Elwali
W8 <i>15/03/2015</i>	Gene regulation <ul style="list-style-type: none"> • The processes controlling expression of genes in prokaryotes • The processes controlling expression of genes in eukaryotes • The relation of gene expression with cell differentiation • Oncogenes and tumor suppressor genes • LincRNA and gene regulation 	Prof Nasr Eldin Elwali
W8 <i>19/03/2015</i>	Midterm exam	
<i>20/3 - 28/3/2015</i>	Mid-Semester Vacation	
W9 <i>29/03/2015</i>	Genetic mutations <ul style="list-style-type: none"> • Mechanisms of gene mutation • Causes of mutation • Implications of genetic mutation 	Prof Nasr Eldin Elwali



W10 <i>05/04/2015</i>	Genetics and hereditary factors <ul style="list-style-type: none"> • Mendelian and classical genetics • The molecular basis of hereditary • Complex traits, genetic linkage, crossing over and recombination • The functional basis of genetic variation; variable protein structure and function • Epigenetics 	Prof. Salahuddin Khan
W10	Quiz 2	
W11 <i>12/04/2015</i>	Protein Receptors and signal transduction pathways <ul style="list-style-type: none"> • G protein couples protein receptor activation by glucagon • Protein tyrosine kinase activation by insulin. 	Prof Nasr Eldin Elwali
W12 <i>19/04/2015</i>	An introduction to the basis of molecular techniques <ul style="list-style-type: none"> • Key components, structures and principles underlying molecular techniques • Restriction enzymes. • Principles of cloning and it applications. 	Dr Arezki Azzi
W13 <i>26/04/2015</i>	An introduction to molecular techniques and their uses <ul style="list-style-type: none"> • Amplification of DNA • General concepts: site directed mutagenesis, microarrays, and gene therapy 	Dr Arezki Azzi
W14 <i>03/05/2015</i>	REVISION WEEK	
W15 <i>10/05/2015</i>	FINAL EXAM	