Lecture complex

Discipline: "Genes and Heredity"

Discipline code: GN 1204

Name of EP: 6B10115 "Medicine"

Study hours/ credit hours: 120 hours/4 credits

Course and semester of study: 1-2

Lecture volume: 2 ч.

Shymkent 2023

The lecture complex was developed in accordance with the working curriculum of the EP "Genes and heredity", the discipline "Molecular biology" and discussed at the meeting of the department.

Protocol no. __6_ of «_28__» ___12_____ 2023 y.

Head of Department, Professor _____ Yessirkepov M.M.

№1

1. Topic: Information macromolecules of the cell.

2. Objective: To give an idea: 1) about the subject, tasks and importance of molecular biology and genetics; 2) about the main informational macromolecules of the cell - NA and proteins; molecular structure, spatial structure and importance in storage and transmission of hereditary information.

3. lecture thesis: Molecular biology is a complex of biological sciences studying the mechanisms of storage, transmission and realisation of genetic information, structure and functions of irregular biopolymers (proteins and nucleic acids).

Molecular biology historically appeared as a section of biochemistry. By the beginning of the XXI century, data on the primary structure of all DNA of humans and a number of other organisms, most important for medicine, agriculture and scientific research, were obtained, which led to the emergence of several new areas in biology: genomics, bioinformatics and others.

Proteins (proteins, polypeptides) are highly molecular organic substances consisting of alpha-amino acids linked by peptide bonds. In living organisms, the amino acid composition of proteins is determined by the genetic code, and in most cases 20 standard amino acids are used in synthesis. Their many combinations give a great variety of properties of protein molecules. In addition, amino acids in a protein are often subjected to post-translational modifications, which can occur both before the protein begins to fulfill its function and during its "work" in the cell. Often in living organisms, several protein molecules form complexes, such as the photosynthetic complex.

Crystals of various proteins grown on the Mir space station and during NASA shuttle missions. Highly purified proteins form crystals at low temperature, which are used to produce a model of a given protein.

The functions of proteins in the cells of living organisms are more diverse than those of other biopolymers such as polysaccharides and DNA. For example, enzyme proteins catalyze biochemical reactions and play an important role in metabolism. Some proteins have a structural or mechanical function, forming the cytoskeleton that maintains the shape of cells. Proteins also play an important role in cell signaling systems, in immune response and in the cell cycle.

Nucleic acids (from Latin nucleus - nucleus) are high-molecular organic compounds, biopolymers (polynucleotides) formed by nucleotide residues. Nucleic acids DNA and RNA are present in the cells of all living organisms and perform the most important functions of storing, transmitting and realising hereditary information. The polymeric forms of nucleic acids are called polynucleotides. Chains of nucleotides are connected through a phosphoric acid residue (phosphodiester bond). Since there are only two types of heterocyclic molecules in nucleotides, ribose and deoxyribose, there are only two types of nucleic acids, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).

DNA - Deoxyribonucleic acid. The sugar is deoxyribose, the nitrogenous bases are purine bases - guanine (G), adenine (A), and pyrimidine bases - thymine (T) and cytosine (C). DNA often consists of two polynucleotide chains directed antiparallel.

RNA - Ribonucleic acid. The sugar is ribose, the nitrogenous bases are the purine bases guanine (G), adenine (A), and the pyrimidine bases uracil (U) and cytosine (C). The structure of the polynucleotide chain is similar to that of DNA. Because of the characteristics of ribose, RNA molecules often have different secondary and tertiary structures, forming complementary regions between different chains

4. illustrative material: Overview

https://www.youtube.com/watch?v=j0sEi_Dscd8&feature=youtu.be Protein

https://www.youtube.com/watch?v=QSfntmjVtpQ&feature=youtu.be Folding

https://www.youtube.com/watch?v=V6YC97Dj5E0&feature=youtu.be NA

5. Literature: see Annex 1

6. Control questions: feedback

1. Genomics and proteomics.
2. Folding (protein folding).Folding factors:

a. chaperones
b. Foldases

3. Prions.
4. Primary, secondary and tertiary structure of DNA (DNA superhelicalisation).
5. The nucleosomal strand.
6. Supranucleosomal stacking of DNA.
7. Physical and chemical properties and functions of DNA.

№2

1. Topic: Expression of genetic material.

2. Objective: to form an idea of the principles of recording genetic information and ways of its realisation.

3. Thesis of the lecture: It is believed that one of the most important properties of the DNA molecule is its spontaneous doubling (replication). Due to DNA replication, hereditary information is transmitted from generation to generation in an unchanged, equilibrium amount and ensures the continuation of offspring. DNA replication occurs at the S - synthetic stage of the cell cycle. Property of DNA molecule replication 1953 J. Watson and F. Crick became known after the discovery that the structure of the DNA molecule has a double helix.

In the theoretical state, 3 different methods of DNA replication are assumed: 1) conservative (stable); 2) semi-conservative; 3) dispersed.

Numerous experiments have shown that replication of the DNA molecule is semi-conservative. One of the first it was noticed in 1958 by M. Meselson and F. Stahl e. in the coli cell.

The DNA molecule of some prokaryotes and all eukaryotes is dash-shaped, and their replication starts from a certain point, the formation of a replicative swelling, and heads to the opposite side of the chromosome. On the large chromosomes of eukaryotes, hundreds of replication swellings occur simultaneously, and they merge with each other to form a U-shaped intermediate structure. This is called semi-conserved replication.

Transcription (Latin transcriptio-copy) is the synthesis of an RNA molecule using a DNA molecule as a matrix. In other words, the transfer of genetic information from DNA to RNA.

Transcription is catalysed by the enzyme DNA-dependent RNA polymerase. RNA synthesis occurs in the direction from the 5'-end to the 3'-end, which means that the RNA polymerase enzyme moves in the 3'->5' direction in the DNA molecule. Transcription consists of initiation, elongation, and termination steps. Organisms with the ability to regulate their genetic activity can better adapt to changes in the external environment. Such regulatory systems are characteristic of all eukaryotic and prokaiotic cells.

4.Illustrative material: Overview

https://www.youtube.com/watch?v=BmAq-EolVCc&feature=youtu.be replication
https://www.youtube.com/watch?v=G7-hNjwCwaw&feature=youtu.be telomere
https://www.youtube.com/watch?v=iv-025Dx8LE&feature=youtu.be transcription
https://www.youtube.com/watch?v=pNoXrbIKlDk&feature=youtu.be CAP
https://www.youtube.com/watch?v=kAuBlqm-oCU&feature=youtu.be splicing

5. Literature: see Annex 1

Russian language:

Basic:
1. Genetics. Textbook for Higher Education Institutions / Edited by Academician of RAMS V.I. Ivanov - Moscow: ICC "Akademkniga", 2006-638c: ill.
2. Muminov T. Fundamentals of molecular biology: a course of lectures. -Almaty: Effekt, 2007.

Additional:
1. Ivanyushkin A.Y., Ignatiev V.N., Korotkikh R.V., SiluyanovaI.V.Izd-vol.
Progress, M.. 2008г.
2. У. Clague, M. Cummings. Fundamentals of Genetics - M.: Technosphere, 2009.
3. Fundamentals of molecular biology of the cell. Textbook. 3 volumes. B. Alberts et al, OZON.RU Publishing House, 2018.

№	Name	Link
1	Electronic library	http://lib.ukma.kz
2	Republican interuniversity electronic library	http://rmebrk.kz/
3	Electronic library of the Medical University "Student Advisor"	http://www.studmedlib.ru
4	"Paragraph" information system "Medicine" section	https://online.zakon.kz/Medicine
5	Scientific electronic library	https://elibrary.ru/
6	Electronic library "BuxMed"	http://www.booksmed.com
7	«Web of science» (Thomson Reuters)	http://apps.webofknowledge.com
8	«Science Direct» (Elsevier)	https://www.sciencedirect.com
9	«Scopus» (Elsevier)	www.scopus.com
10	PubMed	https://www.ncbi.nlm.nih.gov/pubmed

Internet resource:
1. Genetics. Textbook for Higher Education Institutions / Edited by Academician of Russian Academy of Medical Sciences V.I. Ivanov - Moscow: ICC "Akademkniga", 2011-638c: ill.
2. Mushkambarov N.N., Kuznetsov S.N. Molecular biology. Textbook for students of medical universities, 3rd edition, Moscow: Nauka, 2016, 660c.
3. У. Clague, M. Cummings. Fundamentals of genetics - M.: Technosphere, 2009.
4. Kurchanov.A. Human genetics with the basics of general genetics: textbook -SPb, 2009.
5. Alberts B. B., Bray D., Hopkin K. Fundamentals of molecular biology of the cell. Textbook. 2nd ed., revised, per. from Engl. 768st. 2018г.
6. Spirin A.S. Protein biosynthesis, the RHK World and the origin of life.
7. Spirin A.S. Molecular Biology. Structure of ribosomes and protein biosynthesis. - M.: (electronic textbook).

6. Control questions: feedback
1. Semi-conservative steps of replication:
- initiation
- elongation
- termination
2. Factors of initiation, elongation, and termination.
3. Purpose and functions of telomeres.
4. DNA-binding proteins structure and functions.
5. DNA polymerase and its types.
6. PCNA protein, structure and function.