Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 01, Issue 02, December 2025

https://eurekaoa.com/index.php/5

ON THE SYNTHESIS OF NUCLEIC ACIDS AND THEIR ROLE IN THE PRESERVATION AND TRANSMISSION OF INHERITED TRAITS OF THE ORGANISM

Olimjonova Dilnura Doughter's Bakhtiyor
1st-Year Student, Group 25-22a № 2 Medical Department
Tashkent State Medical University

Abstract

This article discusses the synthesis of nucleic acids, their storage and transmission of hereditary traits in the body, as well as the mechanisms that preserve DNA within cells (DNA repair, replication, and chromosome organization with histones). You will learn how these processes protect against mutations and maintain the integrity of the genetic code.

Keywords: Nucleoside 5-triphosphates, nitrogenous base, pentose, phosphoric acid, heterocyclic rings, carbamyl phosphate, guanylic acid.

Introduction

In medicine, scientists have established that nucleoside-5'-triphosphates are the raw materials for the synthesis of nucleic acids. They scientifically substantiated the formation of nitrogenous bases (purine or pyrimidine) from three main components of nucleoside-5'-triphosphates (the nitrogenous base, pentose, and phosphate group) in a specific manner. The pathways for the formation of purine and pyrimidine bases differ. However, there are some similarities in the mechanisms of their formation. These include:

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 01, Issue 02, December 2025

https://eurekaoa.com/index.php/5

1. The widespread use of glycine, asparagine, and glutamine as sources of nitrogen for heterocyclic rings;
2. The incorporation of carbon atoms from carbon dioxide and formate into the purine and pyrimidine rings;
3. The construction of the purine base and the completion of the pyrimidine base synthesis on ribose-5-phosphate, resulting in nucleotide-5-phosphates as the final products of biosynthesis rather than free adenine, guanine, uracil, or thymine;
4. The enzymatic nature of all reactions that occur during nucleotide synthesis.

Let's first consider the pathway of pyrimidine nucleotide biosynthesis. The first step involves the biosynthesis of carbamoyl phosphate from NH3 and CO2 with the participation of ATP.

NH + CO +carbamoylase OH
АТФ
CO P O +
3 2 NH2O АДФ

Then, in the presence of a specific enzyme (aspartate carbamoyltransferase), the carbamoyl group is transferred to the amino group of aspartic acid, forming carbamoylasparagine acid and phosphoric acid:

COOH aspartate COOH
OH carbamoyltransferase
[redacted]
+ Ф
O + CH2 CH2
CH NH2 CO NH CH
OH NH2 COOH COOH

carbamoyl phosphate aspartic acid carbamoyl-aspartic acid

acid

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 01, Issue 02, December 2025

https://eurekaoa.com/index.php/5

When the amino and carboxyl groups of carbamoylasparagine acid combine, a reaction occurs that releases a molecule and forms dihydroorotic acid. This reaction is catalyzed by the enzyme dihydroorotase, which belongs to the class of hydrolases.

O
CH2
dihydroorotaseNHCH2
__ __ -H O COOH
CH
H2N CONH COOH2 O NH

dihydroorotic acid

The resulting dihydroorotic acid is oxidized by dehydrogenase with flavin-adenine dinucleotide (FAD) as a coenzyme to form orotic acid:

O O
dihydroorotate |
dehydrogenase
C C
+ FAD
HNCH2 HN CH
CH
O_C COOH - FAD.H2 O_C C COOH
NH NH
dihydroorotic orotic
acid acid

Orotic acid reacts with 5'-phosphoribosyl-1'-pyrophosphate under the action of an enzyme from the transglycosidase group. This forms the nucleotide orotidine-

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 01, Issue 02, December 2025

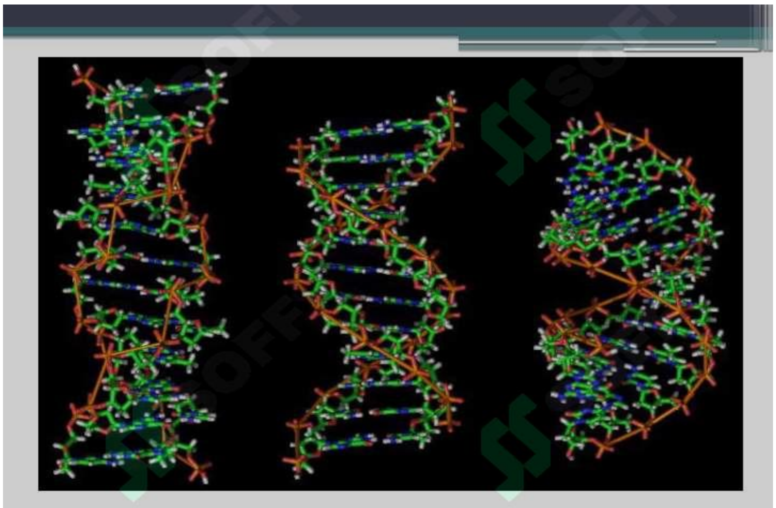
https://eurekaoa.com/index.php/5

5'-phosphate and pyrophosphate. Then, orotidine-5'-phosphate undergoes decarboxylation to form the pyrimidine nucleotide uridine-5'-phosphate.

Uridine-5'-phosphate plays a central role in the biosynthesis of pyrimidine nucleotides, as it can be converted into other pyrimidine nucleotides through reduction, amination, and methylation reactions. All these reactions generate a pool of free pyrimidine nucleoside triphosphates (UTP, CTP, dCTP, dTTP), which are then used for the biosynthesis of DNA and RNA.

In contrast to pyrimidine bases, purine bases are formed directly from 5'-phosphoribosyl-1'-pyrophosphate. The purine ring is formed through a series of reactions involving nitrogen from dicarboxylic amino acids, the amide nitrogen of glutamine, one-carbon fragments (CO2), as well as nitrogen and carbon atoms from glycine.

An important intermediate product in the synthesis of purine nucleoside phosphates is inosine acid, which is formed through 11 sequential enzymatic reactions using five molecules of ATP. Inosine acid can then be converted into adenyl acid and guanylate acid. The synthesis of adenyl acid occurs through the amination of inosine acid by asparagine acid with the use of GTF.



Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 01, Issue 02, December 2025

https://eurekaoa.com/index.php/5

The biosynthesis of guanylic acid also occurs in two stages. First, inosine acid is oxidized to xanthine acid through an oxygenase reaction, then it is aminated by glutamine in the presence of ATP, converting into guanylic acid.

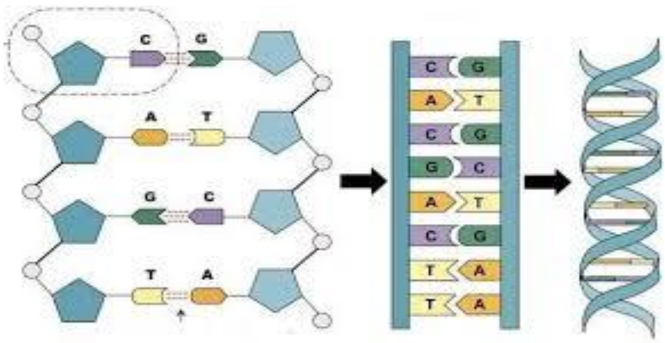
It has been established that the genetic program is localized and stored in the DNA of chromosomes in the nuclei and mitochondria of cells. The transfer of genetic information from DNA to protein via RNA occurs in the protein, which is the main carrier of life. The transfer of genetic information from DNA to DNA (i.e., DNA biosynthesis in the cell) is called replication, reduplication, or self-replication. Replication occurs during cell division and viral reproduction, when it is necessary to transfer complete information from one organism to another.

The transfer of genetic information from DNA to RNA is called transcription or copying. This process copies information only from specific regions of DNA that code for the structure of a particular protein. The transfer of genetic information from RNA to protein is called translation. This process translates only mRNA, and information is transferred from the nucleotide alphabet to the amino acid alphabet, leading to the synthesis of a specific protein.

DNA synthesis (replication) is characterized by several features. The first characteristic feature of DNA biosynthesis is that it occurs only in the presence of four types of deoxyribonucleoside-5'-triphosphates (dATP, dGTP, dCTP, dTTP). The second feature is that DNA biosynthesis occurs under the catalytic action of a complex of enzymes: the DNA replicase system or replisome, which includes more than 20 replicative enzymes and protein factors, including DNA polymerases I, II, and III, RNA polymerase, DNA ligase, DNA-binding, DNA-folding proteins, and others. Finally, the third feature of DNA biosynthesis is the need for a "primer" in the form of an oligoribonucleotide and a DNA template, which ensures the specific biosynthesis of nucleic acids with a strictly defined sequence of nucleotide residues in the synthesized molecule.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 01, Issue 02, December 2025

https://eurekaoa.com/index.php/5



It is believed that an additional mechanism of DNA synthesis can be used to introduce new information into the genome. Scientists believe that studying reverse transcription may play an important role in understanding the transformation of normal cells into cancerous ones and in the development of gene engineering methods. The research of academician V.A., conducted under the guidance of Engelhardt, made a significant contribution to solving this problem.

RNA biosynthesis begins in a region of the DNA molecule called the promoter. Between the promoter and the informative sequence of DNA nucleotide residues lies the operator region. If the operator is not occupied by a repressor protein, the RNA polymerase reaction proceeds by transcription (copying), first of the non-informative region of the operator and then of the informative region (cistron) of the gene, which encodes the structure of a specific protein, rRNA, or tRNA.

Some genetic markers present in the chain, such as DNA methylation and histone modifications, can be passed on to the next generation, but more often they are either reset or lost during generational shifts. This contributes to changes in the density of inheritance but is mostly related to the form of the genetic code.

Eureka Open Access Journals
Open Access | Peer Reviewed | International Journals | Multidisciplinary Areas
Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)
ISSN 2760-4942 (Online) Volume 01, Issue 02, December 2025

https://eurekaoa.com/index.php/5

RECOMMENDED LITERATURE

1. Molecular Fundamentals of Heredity: A Textbook / O.V. Voronkova [et al.]. – Tomsk: SibGMU Publishing House, 2021. – 115 p.
2. Nucleic Acids: From A to Z / B. Appel, B.I. Beneke, Y. Benenson / Ed. S. Müller. Translated from English. – Moscow: BINOM. Laboratory of Knowledge, 2013. – 413 p.
3. Molecular Biology: A Textbook for Universities / A.S. Konichev, G.A. Sevastyanova, I.L. Tsvetkov. – 5th ed. – Moscow: Yurait Publishing House, 2021. – 422 p. – ISBN 978-5-534-13468-1 – Text: direct.
4. Shodmonov X.Q., Eshmurodov X.Sh., Tursunova O.T. "Nervous and Mental Disorders" – Tashkent, 2004.
5. General Practice Doctor's Handbook. Edited by Academician RAMN, R. Paleeva. EKSMO, 2002.
6. Ismailovich S.A. "Social-Psychological Problems of Developing Independent Thinking". Creative Personality in the Educational Process / / Central Asian Literature Journal.