

Check your knowledge

Explain at least 3 ways that DNA differs from RNA.

Answer: DNA nucleotides contain the 5-carbon sugar deoxyribose and four types of nitrogenous bases, adenine (A) and guanine (G), and cytosine (C) and thymine (T). The nucleotides that make up RNA contain the 5-carbon sugar ribose. RNA nucleotides also have nitrogenous bases, however the four types of RNA nitrogenous bases are: adenine (A) and uracil (U), and cytosine (C) and guanine (G). RNA exists as shorter single-stranded molecules rather than long double-stranded helices like DNA. There are several kinds of RNA including messenger RNA (mRNA), transfer RNA (tRNA), and ribosomal RNA (rRNA). All three RNA molecules are involved in the production of proteins from the DNA. DNA stores the genetic information needed to build and control the cell.

CONCEPTS IN ACTION– See more about comparing DNA and RNA in [this video](#).

Section Summary

The model of the double-helix structure of DNA was proposed by Watson and Crick with the assistance of information from Franklin, Wilkins, and Chargaff. The DNA molecule is a polymer of nucleotides. Each nucleotide is composed of a nitrogenous base, a five-carbon sugar (deoxyribose), and a phosphate group. There are four nitrogenous bases in DNA, two purines (adenine and guanine) and two pyrimidines (cytosine and thymine). A DNA molecule is composed of two strands. Each strand is composed of nucleotides bonded together covalently between the phosphate group of one and the deoxyribose sugar of the next. Nitrogenous bases extend from the sugar-phosphate backbone. The bases of one strand bond to the bases of the second strand with hydrogen bonds. Adenine always bonds with thymine, and cytosine always bonds with guanine. The bonding causes the two strands to spiral around each other in a shape called a double helix. Ribonucleic acid (RNA) is a second nucleic acid found in cells. RNA is a single-stranded polymer of nucleotides. It also differs from DNA in that it contains the sugar ribose, rather than deoxyribose, and the nucleotide uracil rather than thymine. Various RNA molecules function in the process of forming proteins from the genetic code in DNA.

Exercises

1. Which of the following does cytosine pair with?
 - a. guanine
 - b. thymine
 - c. adenine
 - d. a pyrimidine
2. Whose x-ray crystallography data was used to determine the structure of DNA?
 - a. James Watson
 - b. Francis Crick
 - c. Erwin Chargaff
 - d. Rosalind Franklin
3. Describe the structure and complementary base pairing of DNA.

Answers

1. (a)
2. (d)
3. A single strand of DNA is a polymer of nucleic acids joined covalently between the phosphate group of one and the deoxyribose sugar of the next to form a “backbone” from which the nitrogenous bases stick out. In its natural state, DNA has two strands wound around each other in a double helix. The bases on each strand are bonded to each other with hydrogen bonds. Only specific bases bond with each other; adenine bonds with thymine, and cytosine bonds with guanine.

Glossary

deoxyribonucleic acid (DNA): stores the genetic information needed to build and control the cell.

deoxyribose: a five-carbon sugar molecule with a hydrogen atom rather than a hydroxyl group in the 2' position; the sugar component of DNA nucleotides

double helix: the molecular shape of DNA in which two strands of nucleotides wind around each other in a spiral shape

nitrogenous base: a nitrogen-containing molecule that acts as a base; often referring to one of the purine or pyrimidine components of nucleic acids

nucleotide: monomers of nucleic acids. Consist of a five-carbon sugar, phosphate group, and nitrogenous base

ribonucleic acid (RNA): RNA molecules are involved in the production of proteins from the DNA.

ribose: a five-carbon sugar molecule with hydroxyl group in the 2' position; the sugar component of RNA nucleotides