Edexcel (B) Biology A-level

1.4 - DNA and protein synthesis

Flashcards

Draw the structure of a nucleotide.

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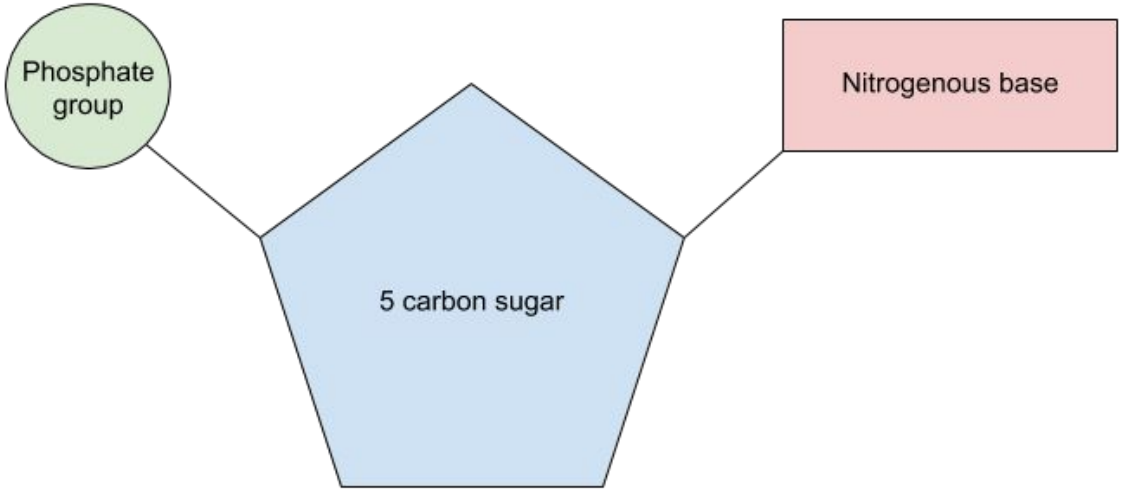
Answer



Name the pentose sugars in DNA & RNA.

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DNA: deoxyribose

RNA: ribose

Describe how polynucleotide strands form.

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Condensation reactions between nucleotides form strong phosphodiester bonds (sugar-phosphate backbone).

Describe the structure of DNA.

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Double helix of 2 deoxyribose polynucleotide strands (so there are 2 sugar-phosphate backbones).

H-bonds between **complementary base pairs** on opposite strands (AT & GC).

Name the purine bases and describe their structure.

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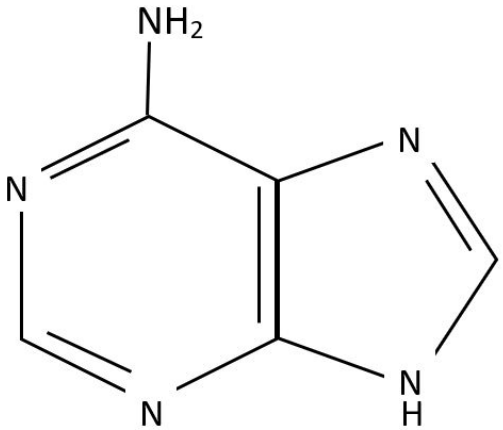
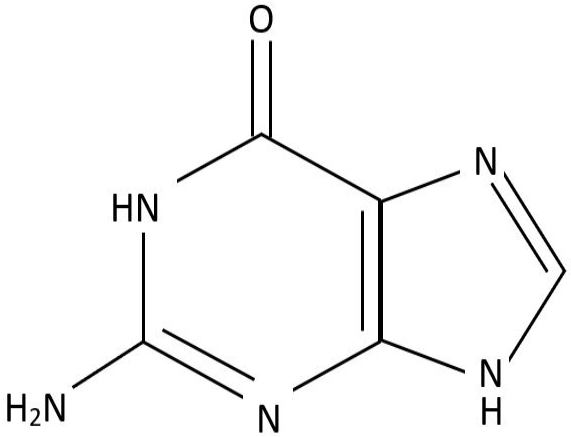
adenine $C_5H_5N_5$ guanine $C_5H_5N_5O$



two-ring molecules

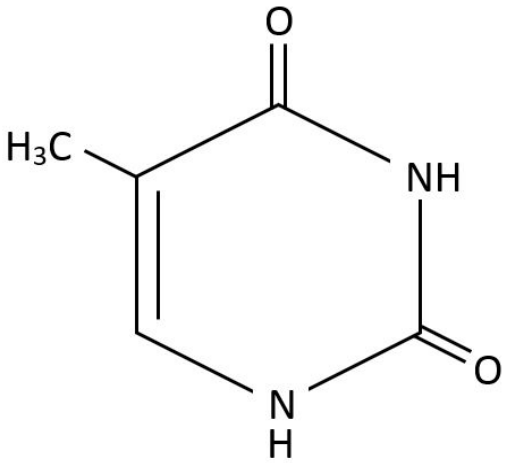


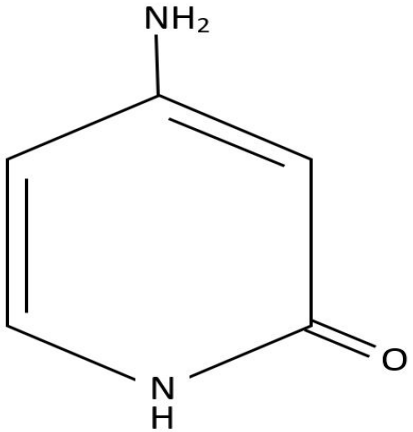
Name the pyrimidine bases and describe their structure.

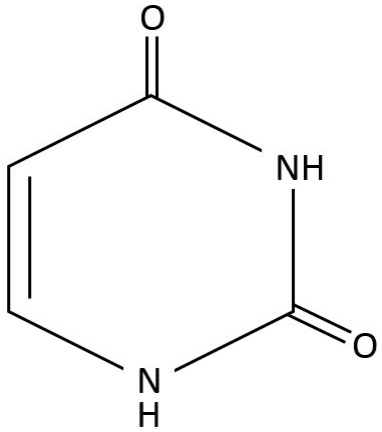
Name the pyrimidine bases and describe their structure.

one-ring molecules

thymine $C_5H_6N_2O_2$ cytosine $C_4H_5N_3O$ uracil $C_4H_4N_2O_2$







Name the complementary base pairs in DNA.

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2 H-bonds between

adenine (**A**) + thymine (**T**)

3 H-bonds between

guanine (**G**) + cytosine (**C**)

Name the complementary base pairs in RNA.

Name the complementary base pairs in RNA.

2 H-bonds between

adenine (**A**) + uracil (**U**)

3 H-bonds between

guanine (**G**) + cytosine (**C**)

Why is DNA replication described as semiconservative?

Why is DNA replication described as semiconservative?

Strands from original DNA molecule act as templates.

New DNA molecule contains 1 old strand & 1 new strand.

Explain the role of DNA helicase in semiconservative replication.

Explain the role of DNA helicase in semiconservative replication.

Breaks H-bonds between base pairs to form 2 single strands, each of which can act as a template.

How is a new strand formed during semiconservative replication?

How is a new strand formed during semiconservative replication?

1. Free nucleotides from nuclear sap attach to exposed bases by complementary base pairing.
2. **DNA polymerase** joins adjacent nucleotides on new strand in a 5' → 3' direction via condensation reactions to form phosphodiester bonds.
3. H-bonds reform.

Explain the role of DNA ligase.

Explain the role of DNA ligase.

Leading strand is replicated continuously in same direction as replication fork. Lagging strand is replicated in Okazaki fragments in the opposite direction.

DNA ligase joins gaps in fragments to form a continuous strand.

Define gene.

Define gene.

A sequence of bases on a DNA molecule that codes for a specific sequence of amino acids to make a polypeptide. Can also code for functional RNA.

Describe the structure of messenger RNA (mRNA).

Describe the structure of messenger RNA (mRNA).

- Long ribose polynucleotide with sugar-phosphate backbone.
- Nitrogenous bases: A, U, G, C.
- Single-stranded & linear (no H-bonds between complementary base pairs).
- Codon sequence is complementary to exons of 1 gene from 1 DNA strand.

Describe the structure of transfer RNA (tRNA).

Describe the structure of transfer RNA (tRNA).

- Single strand folded into clover shape (some paired bases).
- Anticodon on one end, amino acid binding site on the other.

a. anticodon binds to complementary mRNA codon
b. amino acid corresponds to anticodon

What does transcription produce and where does it occur?

What does transcription produce and where does it occur?

produces mRNA

occurs in nucleus

Outline the process of transcription.

Outline the process of transcription.

1. RNA polymerase binds to promoter region on a gene.
2. Section of DNA uncoils into 2 strands with exposed bases. Antisense strand acts as template.
3. Free nucleotides are attracted to their complementary bases.
4. RNA polymerase joins adjacent nucleotides to form phosphodiester bonds.

What happens after a strand of mRNA is transcribed?

What happens after a strand of mRNA is transcribed?

- RNA polymerase detaches at terminator region.
- H-bonds reform & DNA rewinds.
- Splicing removes introns from pre-mRNA in eukaryotic cells.
- mRNA moves out of nucleus via nuclear pore & attaches to ribosome.

State the function of mRNA.

State the function of mRNA.

Transfers genetic code from DNA in nucleus to ribosomes for translation into a specific polypeptide.

What is the antisense strand of DNA?

What is the antisense strand of DNA?

Template strand of DNA which is transcribed.

What is the sense strand of DNA?

What is the sense strand of DNA?

Strand with the same base sequence as mRNA (but with thymine instead of uracil).

What does translation produce and where does it occur?

What does translation produce and where does it occur?

Produces proteins.

Occurs in cytoplasm on ribosomes.

Outline the process of translation.

Outline the process of translation.

1. Ribosome moves along mRNA until ‘start’ codon.
2. tRNA anticodon attaches to complementary bases on mRNA.
3. Condensation reactions between amino acids on tRNA form peptide bonds.
4. Process continues to form polypeptide chain until ‘stop’ codon is reached.

State the role of ATP during translation.

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ATP hydrolysis provides energy to form peptide bonds.

Describe 3 features of the genetic code.

Describe 3 features of the genetic code.

- **Non-overlapping**: each triplet is only read once.
- **Degenerate**: more than one triplet codes for the same amino acid (64 possible triplets for 20 amino acids).
- **Universal:** same bases and sequences used by all species.

What are DNA triplets?

What are DNA triplets?

Sequences of 3 bases that code for a particular amino acid.

What is a start codon?

What is a start codon?

Nucleotide triplet AUG on mRNA codes for the amino acid Met & initiates translation of a polypeptide.

What is a stop codon?

What is a stop codon?

Nucleotide triplets on mRNA which do not code for an amino acidd & terminate translation:

UAA, UAG, UGA

What are exons and introns?

What are exons and introns?

Exons: regions of DNA that code for amino acid sequences. Separated by one or more introns.

Introns: majority of DNA consists of non-coding regions within and between genes.

What is a mutation?

What is a mutation?

Any change in the base sequence of DNA. Often arise spontaneously during DNA replication.

What is a substitution mutation?

What is a substitution mutation?

One nucleotide in the DNA sequence is replaced by another. This is more likely to be a silent mutation which does not change amino acid sequence.

What is a deletion mutation?

What is a deletion mutation?

A nucleotide in the DNA sequence is lost, leading to a **frame shift**. Significant since entire amino acid sequence downstream of mutation will be different.

What is an insertion mutation?

What is an insertion mutation?

Addition of one or more base pairs to DNA sequence, often in microsatellite regions. Causes frameshift. Significant since entire amino acid sequence downstream of mutation will be different.

What is sickle cell anaemia?

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Genetic condition that results in abnormal haemoglobin. Impaired ability to transport oxygen = rapid heart rate, fatigue, dizziness. Sickle shaped red blood cells ‘stick’ in vessels.

What causes sickle cell anaemia in humans?

What causes sickle cell anaemia in humans?

Missense point mutation in gene that codes for β strand in haemoglobin.

On DNA: CTC (Glut) $\rightarrow$ CAC (Val)

Change in primary structure = different tertiary structure. Abnormal haemoglobin molecules form strands that make red blood cells sickle shaped.