WJEC (Eduqas) Biology A-level

Topic 1.5 - Nucleic acids

Flashcards

What are the monomers of nucleic acids?

What are the monomers of nucleic acids?

Nucleotides

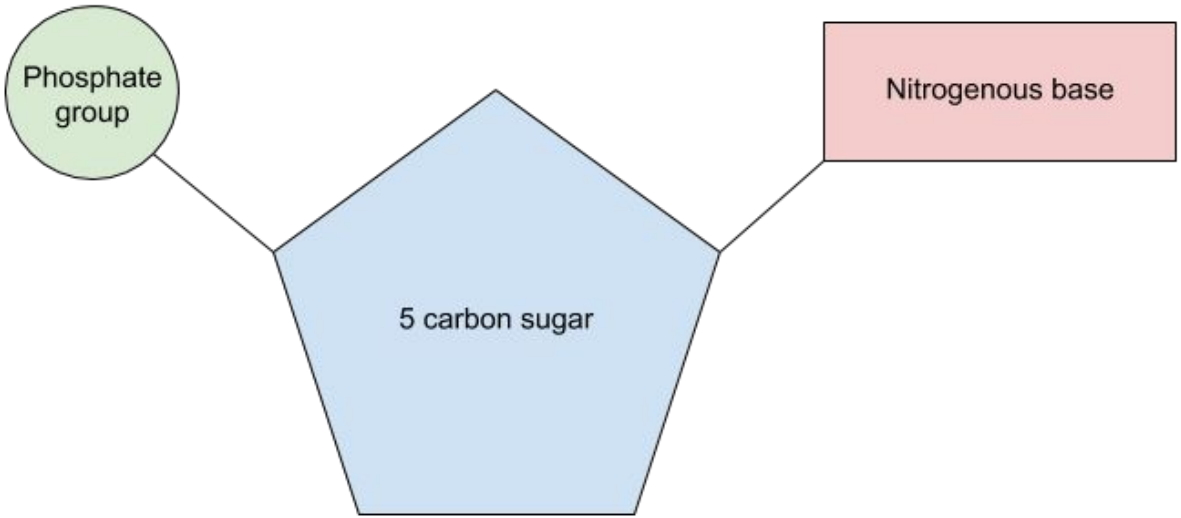
State the three components of nucleotides.

State the three components of nucleotides.

- Pentose sugar
- Organic base
- Phosphate group

Draw the structure of a nucleotide.

Draw the structure of a nucleotide.



What are the two types of organic base?

What are the two types of organic base?

Purine and pyrimidine

What is a purine?

What is a purine?

- Class of organic bases
- Double ring structure
- Includes adenine (A) and guanine (G)

What is a pyrimidine?

What is a pyrimidine?

- Class of organic bases
- Single ring structure
- Includes cytosine (C), thymine (T), uracil (U)

Describe the structure of a DNA nucleotide.

Describe the structure of a DNA nucleotide.

- Deoxyribose
- Organic base (A, T, C or G)
- Phosphate group

Describe the structure of an RNA nucleotide.

Describe the structure of an RNA nucleotide.

- Ribose
- Organic base (A, U, C or G)
- Phosphate group

Describe the structure of an ATP nucleotide.

Describe the structure of an ATP nucleotide.

- Ribose
- Adenine
- Three phosphate groups

What is an endergonic reaction?

What is an endergonic reaction?

A non-spontaneous reaction that requires an input of energy, e.g. ATP formation.

What is an exergonic reaction?

What is an exergonic reaction?

A spontaneous reaction that overall releases energy, e.g. ATP hydrolysis.

Describe the role of ATP.

Describe the role of ATP.

Universal energy currency. Hydrolysed to release energy:

$$ATP + Water \rightleftharpoons ADP + Pi + Energy$$

What is complementary base pairing?

What is complementary base pairing?

- Describes how hydrogen bonds form between complementary purine and pyrimidine bases
- **Two bonds** form between **A** and **T** (or **U**)
- **Three bonds** form between **G** and **C**

Describe the structure of DNA.

Describe the structure of DNA.

- **Double-stranded** polymer of nucleotides twisted to form a double helix
- Nucleotides joined by **phosphodiester** bonds
- Hydrogen bonds form between **complementary base pairs**, A and T, C and G
- **Antiparallel** strands

Why are the strands of a DNA double helix described as ‘antiparallel’?

Why are the strands of a DNA double helix described as ‘antiparallel’?

The complementary strands run parallel but in opposite directions, 5’ to 3’ and 3’ to 5’.

Describe the structure of RNA.

Describe the structure of RNA.

- **Single-stranded** polymer of nucleotides
- Nucleotides joined by **phosphodiester** bonds
- Hydrogen bonds form between **complementary base pairs**, A and U, C and G

Compare and contrast DNA and RNA.

Compare and contrast DNA and RNA.

DNA	RNA
Double-stranded	Single-stranded
Long chain of nucleotides	Shorter chain of nucleotides
Contains deoxyribose sugar	Contains ribose sugar
Contains bases A, T, C and G	Contains bases A, U, C and G
Storage of genetic information	Role in protein synthesis
Phosphodiester bonds join nucleotides	Phosphodiester bonds join nucleotides

Name the three types of RNA found in cells.

Name the three types of RNA found in cells.

- Transfer RNA (tRNA)
- Messenger RNA (mRNA)
- Ribosomal RNA (rRNA)

What is the function of tRNA?

What is the function of tRNA?

It carries specific amino acids to the ribosomes.

Describe the structure of tRNA.

Describe the structure of tRNA.

- 80 nucleotides
- Single helix
- Clover leaf shape
- **Anticodon** on one end, amino acid binding site on the other

What is the function of mRNA?

What is the function of mRNA?

Carries genetic information from the nucleus to the ribosomes for protein synthesis.

Describe the structure of mRNA.

Describe the structure of mRNA.

- 2000 nucleotides
- Single helix
- Unstable

What is the function of rRNA?

What is the function of rRNA?

Associates with proteins in the cytoplasm to form ribosomes.

Describe the structure of rRNA.

Describe the structure of rRNA.

- 1800 to 5000 nucleotides
- Two subunits: one large, one small

What is semi-conservative replication?

What is semi-conservative replication?

The replication of DNA to produce two new DNA molecules which both contain one new strand and one old strand from the original DNA molecule.

What is the role of DNA helicase in semi-conservative replication?

What is the role of DNA helicase in semi-conservative replication?

It catalyses the unzipping of double-stranded DNA into two single strands, each of which acts as a template.

What is the role of DNA polymerase in semi-conservative replication?

What is the role of DNA polymerase in semi-conservative replication?

It catalyses the formation of phosphodiester bonds between nucleotides during the synthesis of a new DNA strand.

What is the genetic code?

What is the genetic code?

The rules by which triplets in a DNA base sequence code for the sequence of amino acids in a polypeptide chain. The genetic code is **degenerate**, **universal** and **non-overlapping**.

Why is the genetic code described as degenerate?

Why is the genetic code described as degenerate?

More than one triplet can code for a particular amino acid.

Why is the genetic code described as universal?

Why is the genetic code described as universal?

The same codons code for the same amino acids in almost all organisms.

What is meant by ‘non-overlapping’?

What is meant by ‘non-overlapping’?

Each base in a sequence is read once and is only part of one triplet.

Describe the ‘triplet code’ for amino acids.

Describe the ‘triplet code’ for amino acids.

A specific sequence of three nucleotides (known as a **codon**) on a molecule of DNA or RNA codes for a particular amino acid in protein synthesis.

What is an exon?

What is an exon?

A region of DNA that codes for an amino acid sequence.

What is an intron?

What is an intron?

A non-coding sequence of DNA that is found between exons.

Compare eukaryotic and prokaryotic genes.

Compare eukaryotic and prokaryotic genes.

- Eukaryotic genes are **discontinuous** with non-coding introns and coding exons
- Prokaryotic genes are **continuous** with coding sequences only

What is protein synthesis?

What is protein synthesis?

The formation of proteins from amino acids. There are two stages: **transcription** and **translation**.

Define transcription

Define transcription

- First stage of protein synthesis
- The formation of pre-mRNA in eukaryotes and mRNA in prokaryotes from a section of the template strand of DNA

Outline the process of transcription.

Outline the process of transcription.

1. **DNA helicase** unwinds section of DNA, breaking hydrogen bonds between the DNA strands. **Antisense** strand acts as a **template**.
2. **RNA polymerase** binds to promoter region on a gene
3. **Free RNA nucleotides** align next to their complementary bases
4. RNA polymerase joins adjacent RNA nucleotides, forming **phosphodiester bonds**
5. RNA polymerase reaches stop codon and detaches. mRNA complete.

Describe post-transcriptional modification.

Describe post-transcriptional modification.

Splicing removes introns from pre-mRNA in eukaryotic cells.

Define translation

Define translation

- Second stage of protein synthesis
- Takes place in the **ribosomes**
- mRNA used as a template for the attachment of tRNA molecules with complementary anticodons. Amino acids carried on adjacent tRNA molecules are joined to form a polypeptide chain

Outline the process of translation.

Outline the process of translation.

1. mRNA attaches to groove between subunits of ribosome
2. Ribosome moves along mRNA until ‘start’ codon reached
3. Amino acid-tRNA complex anticodon attaches to **complementary** mRNA codon via **hydrogen bonding**. Another complex binds
4. **Peptide bond** forms between adjacent amino acids in the complexes
5. Ribosome moves along one codon and release empty tRNA. Process continues to form polypeptide chain until ‘stop’ codon is reached.

What is the ‘one gene - one polypeptide’ hypothesis?

What is the ‘one gene - one polypeptide’ hypothesis?

The theory that each gene encodes a single protein.

What happens to the polypeptide after translation?

What happens to the polypeptide after translation?

- Further modified by adding carbohydrates, lipids or phosphates
- Different polypeptides may be combined

Describe how DNA can be purified by precipitation.

Describe how DNA can be purified by precipitation.

- Add ethanol and a salt to aqueous solution. Nucleic acids precipitate out of solution
- Centrifuge to obtain pellet of nucleic acid
- Wash pellet with ethanol and centrifuge again