

# Edexcel IAL Biology A-level

## 2.8-2.14 - Nucleotides and Nucleic Acids

### Flashcards

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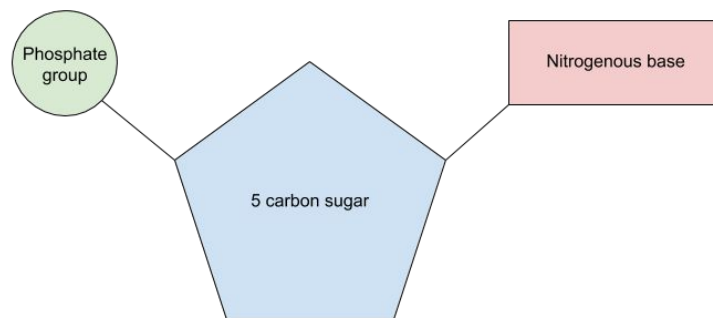


# Draw the structure of a nucleotide



# Draw the structure of a nucleotide

A pentose (5 carbon) sugar (either ribose or deoxyribose), a phosphate group and a nitrogenous base (either adenine, guanine, cytosine, thymine or uracil)



Name the pentose sugars in DNA & RNA



Name the pentose sugars in DNA & RNA

DNA: deoxyribose

RNA: ribose



# Describe how polynucleotide strands form



Describe how polynucleotide strands form

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



# Describe the structure of DNA





Describe the structure of DNA.



**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)



# Describe the structure of RNA



Describe the structure of RNA.

Single stranded. Made up of ribose mononucleotides, linked through condensation reactions. Possible bases are A, C, G and U. C pairs with G, A pairs with U



Name the complementary base pairs in  
DNA



Name the complementary base pairs in DNA.

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 one old strand and one new strand



# Summarise the process of DNA replication



## Summarise the process of DNA replication

1. Double helix unwinds and the hydrogen bonds break, catalysed by DNA helicase
2. Complementary base pairing occurs between the template strand and free nucleotides
3. The nucleotides are joined by phosphodiester bonds, catalysed by DNA polymerase



What is the role of the enzyme DNA polymerase in DNA replication?



What is the role of the enzyme DNA polymerase in DNA replication?

It catalyses the formation of phosphodiester bonds between the free nucleotides to form the new complementary strand of DNA



# Describe the Meselson and Stahl experiment procedure



# Describe the Meselson and Stahl experiment procedure

- E. coli bacteria was grown in a growth medium containing an isotope of nitrogen ( $^{15}\text{N}$ )
- The bacteria incorporated the isotope into the nucleotides
- The bacteria were allowed to divide and samples were taken after each division
- The samples were centrifuged using a salt with a density gradient



# Describe the results from the Meselson and Stahl experiment



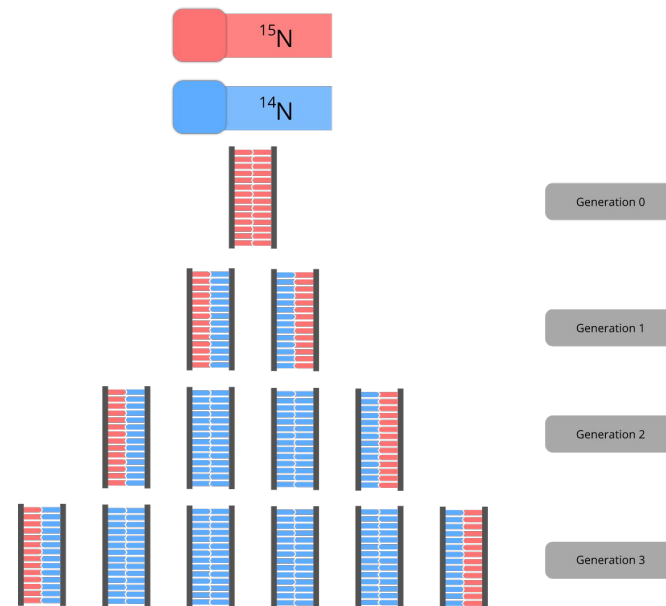


# Describe the results from the Meselson and Stahl experiment

Generation 0 - All DNA contains only  $^{15}\text{N}$  nucleotides

Generation 1 - DNA produces a band showing an intermediate density which is due to the new DNA molecules produced containing one  $^{15}\text{N}$  strand and one  $^{14}\text{N}$  strand

Generation 2 - An intermediate band is also seen but there is now also a band showing a density of just  $^{14}\text{N}$ , proving that replication has to occur semi-conservatively



# What is the genetic code?



# What is the genetic code?

The genetic code is a term used to describe the linear sequence of nucleotides that determine the amino acid sequence in a protein



# What is meant by a triplet code?



## What is meant by a triplet code?

A triplet code is a section of DNA where groups of 3 nucleotides code for one amino acid



What is meant by the genetic code being non-overlapping?



What is meant by the genetic code being non-overlapping?

Each nucleotide is part of only one codon. A single nucleotide cannot be part of two adjacent codons.



What is meant by the genetic code being degenerate?





What is meant by the genetic code being degenerate?

Amino acids can be coded for by multiple different triplets. For example, AGA and CGA both code for the amino acid arginine



# What is a gene?



# What is a gene?

A section of DNA that codes for the sequence of amino acids in a protein



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



# 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 role of RNA polymerase in transcription?





What is the role of RNA polymerase in transcription?

It catalyses the formation of phosphodiester bonds between adjacent RNA nucleotides to form the mRNA strand



# 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

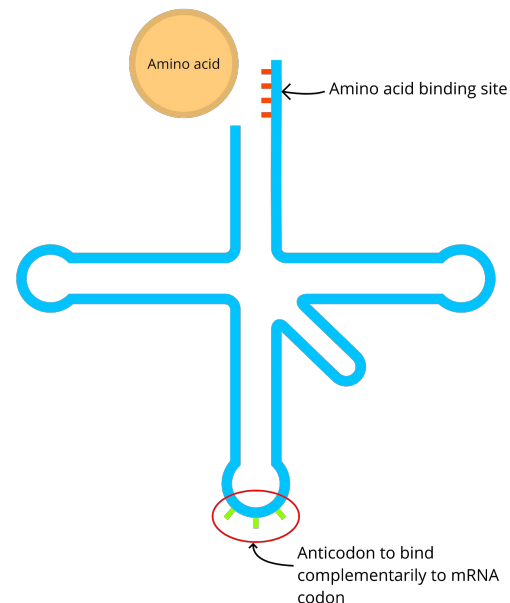


# Describe the structure of transfer RNA (tRNA)



# 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



State the function of transfer RNA (tRNA)



State the function of transfer RNA (tRNA)

Carries amino acids to specific codons  
on mRNA for translation



# What is a codon?





What is a codon?

Three consecutive nucleotides which code for one amino acid



# What is an anticodon?



# What is an anticodon?

A sequence of three bases on a tRNA molecule which is **complementary** to a codon on an mRNA molecule



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) mRNA travels to a ribosome
- 2) The mRNA is passed through the ribosome 3 bases (one codon) at a time
- 3) tRNA molecules with complementary anticodons to the mRNA codons hydrogen bond
- 4) The ribosome catalyses the formation of peptide bonds between the amino acids on the tRNA molecules
- 5) tRNA molecules leave, the ribosome moves along the mRNA and the cycle repeats until the polypeptide has been synthesised
  - **This process requires ATP**



# What is a mutation?





# What is a mutation?

A random change to the base sequence in DNA which results in genetic variants



# List 3 types of mutations



## List 3 types of mutations

- Insertion mutation
- Deletion mutation
- Substitution mutation

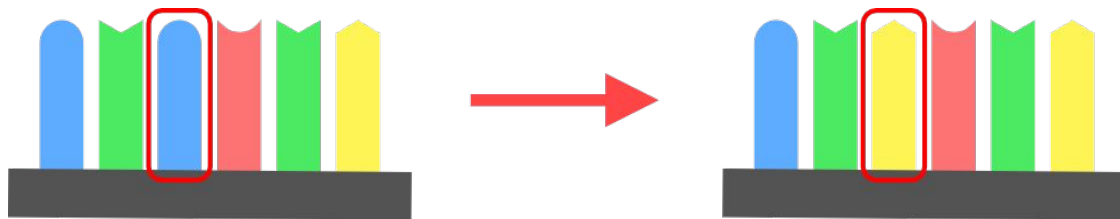


# What is a substitution mutation?



# What is a substitution mutation?

Where one base gets swapped for another base

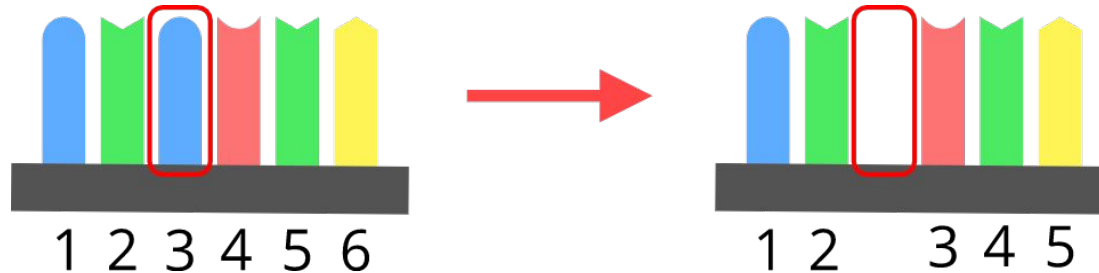


# What is a deletion mutation?



# What is a deletion mutation?

Where one or more bases are removed. This results in a **frameshift mutation** which alters all the codons after the error



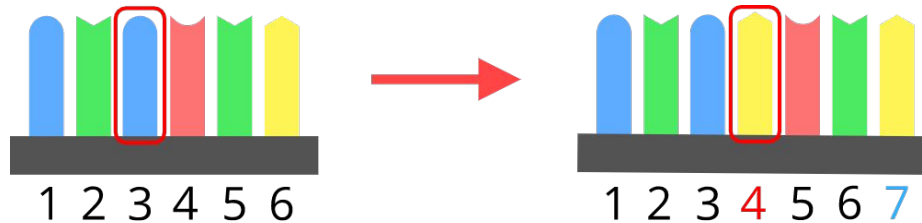
# What is an insertion mutation?





# What is an insertion mutation?

Where one or more bases are added. This results in a **frameshift mutation** which alters all the codons after the error



Give 3 effects of mutations



# Give 3 effects of mutations

**Harmful** - Can cause cellular damage and disease through the production of non-functional proteins

**Neutral** - The mutation causes no noticeable change to the function of the protein produced

**Beneficial** - Mutations which can prove beneficial to organisms and may produce proteins that are better adapted to their functions. This can give organisms a selective advantage



# What is cancer?



# What is cancer?

A non-communicable disease which is characterised by uncontrolled cell division. It can be caused by mutations in regulatory genes

