

AS 90715 Describe the role of DNA in relation to gene expression
Protein Synthesis Questions

(2011:2)

Insulin is a protein that is made up of two separate polypeptide chains. The A-chain is 21 amino acids long, and the B-chain 30 amino acids long. The amino acid sequence of insulin is shown in the diagram.



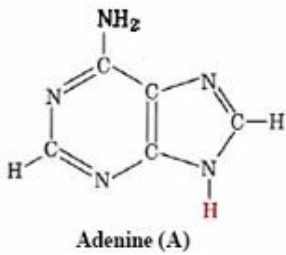
http://www.abpishools.org.uk/res/coResourceImport/modules/diabetes_16plus/en-images/chains.gif

Discuss how original DNA sequences lead to the formation of proteins such as the one shown above. In your answer you should consider:

- a description of transcription and translation
- an explanation of the role of RNA
- formation of the final protein structure from the polypeptide chain.

(2010:1a)

The diagram shows a section of one nucleic acid, DNA. All nucleic acids are molecules made up of repeating units called **nucleotides**.



(a) Discuss the significance of changes in parts of the nucleotide. In your answer you should:

- describe changes that may occur within the nucleotides of DNA
- describe how nucleotides differ between strands of DNA and mRNA
- compare the significance of the differences in **structure AND function** of DNA and mRNA.

(2010:1a,c)

(a) Use the codon table provided to complete the table below to show how DNA bases code for amino acids.

DNA template strand	CGA	TCA	GCT	ACC	TCT
mRNA					
Amino acids					

First Position	Second Position				Third Position
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

(c) Explain how **enhancers, promoters** and the presence of **transcription factors** control the production of proteins in eukaryotic cells.

(2009:1b, c)

- (b) Describe the role of transcription in the formation of a protein such as neurofibromin.
- (c) Explain how mRNA is processed once it has been transcribed.

(2008:1)

DNA and RNA are two types of nucleic acid.

(a) Complete the following table by giving the features of these two molecules.

	DNA	RNA
Bases present		
Relative length		
Sugar		
Location in eukaryote cell		

(b) Discuss how the arrangement of bases in the DNA molecule allows it to carry genetic information. Your answer **should** include information on the significance of:

- sequence of bases on the DNA
- nature of the code (codons)
- redundancy of the genetic code.

(2008:2)

Eukaryote genes include both **introns** and **exons**, but prokaryote genes contain neither.

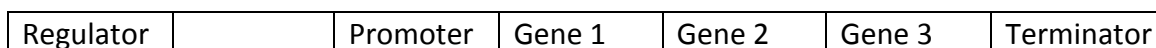
(a) Describe what is meant by the terms **intron** and **exon**.

(b) In eukaryotes the length of the mRNA molecule produced by transcription is less than the length of the gene itself. This is due to RNA splicing. Explain why the length of an mRNA molecule transcribed from a eukaryote gene is shorter than the original gene's DNA sequence.

(c) Discuss how the mRNA transcript is translated into a polypeptide chain on the ribosome. You should include information about:

- tRNA
- codons and anticodons
- peptide bonds
- start and stop codons.

(d) In bacteria, the genes coding for proteins involved in lactose metabolism are grouped together in an operon. The following diagram of a length of DNA shows an operon and its related regulator gene site.



Describe the role of the **promoter**.

(e) The **lac** operon controls metabolism of the sugar lactose. The genes are not expressed unless lactose is present in the cell's environment.

Explain the role of lactose in expression of the lac operon.

(2007:1c)

The information carried by DNA controls protein synthesis. Protein synthesis includes transcription and translation.

(c) Discuss the reasons why **both** transcription and translation are necessary for protein synthesis.

(2006:2)

Deoxyribonucleic acid (DNA) is found in almost all cells, and carries the genetic code that controls many aspects of cellular structure and function.

(a) Explain how the DNA molecule carries genetic information.

(b) Compare and contrast the processes of **transcription** and **translation**.

The proteins that some genes code for are constantly expressed, e.g. those involved in cellular respiration. Other proteins are produced only as needed, i.e. the expression of these genes is controlled.

(c) Explain the role of **enhancers** in **eukaryote** gene expression.

(d) Discuss reasons for the role of **inducers** and **repressors** in **prokaryote** gene expression.