

AS91159 Demonstrate understanding of gene expression

Protein synthesis

(2017: 1) Protein synthesis

(a) In the table below, draw a DNA and an RNA molecule, each composed of the FOUR different nucleotides that are specific to each molecule.

In your answer you must include and label where appropriate:

- phosphate
- sugar (deoxyribose or ribose)
- nitrogenous bases (adenine, cytosine, guanine, thymine, and uracil)
- hydrogen bond.

DNA	RNA

(b) Discuss the relationship between DNA, mRNA, and tRNA in protein synthesis.

In your answer include:

- an explanation of the key stages of protein synthesis
- an explanation of why tRNA is shorter than mRNA, when considering their function
- a discussion, with two justified reasons, why DNA is not directly translated into a polypeptide chain

(2016: 1) Nucleic acids

(a) Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) are both involved in protein synthesis.

Describe the structure of DNA and RNA. You may use diagrams in your answer.

(b) DNA, mRNA, and tRNA are all involved in the formation of proteins.

Discuss the significance of these molecules in forming proteins, and why the cell continually makes mRNA molecules, but not DNA molecules, during protein synthesis.

In your answer include:

- an explanation of the function of DNA, mRNA, and tRNA molecules
- an explanation of how mRNA is produced
- a discussion of the significance of DNA, mRNA, and tRNA in forming specific proteins.

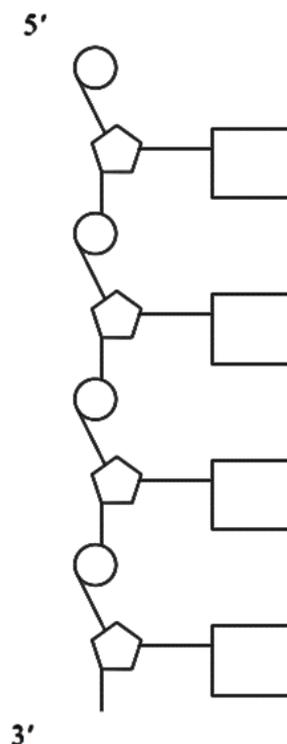
(2015, 1)

(a) The structure of DNA is made up of nitrogen bases, deoxyribose sugars, and phosphates.

Draw the corresponding **anti-parallel** complementary strand in the box below.

In your answer:

- fill in the template strand containing the bases adenine (A), thymine (T), guanine (G), cytosine (C)
- draw the corresponding **anti-parallel** complementary strand
- draw and label the sugars
- draw and label the phosphates.



(b) Protein synthesis is the process of making proteins. Triplets, codons, and anti-codons are important components in the process.

Discuss the relationship between triplets, codons, and anti-codons, and how they interact to form a protein.

In your answer include:

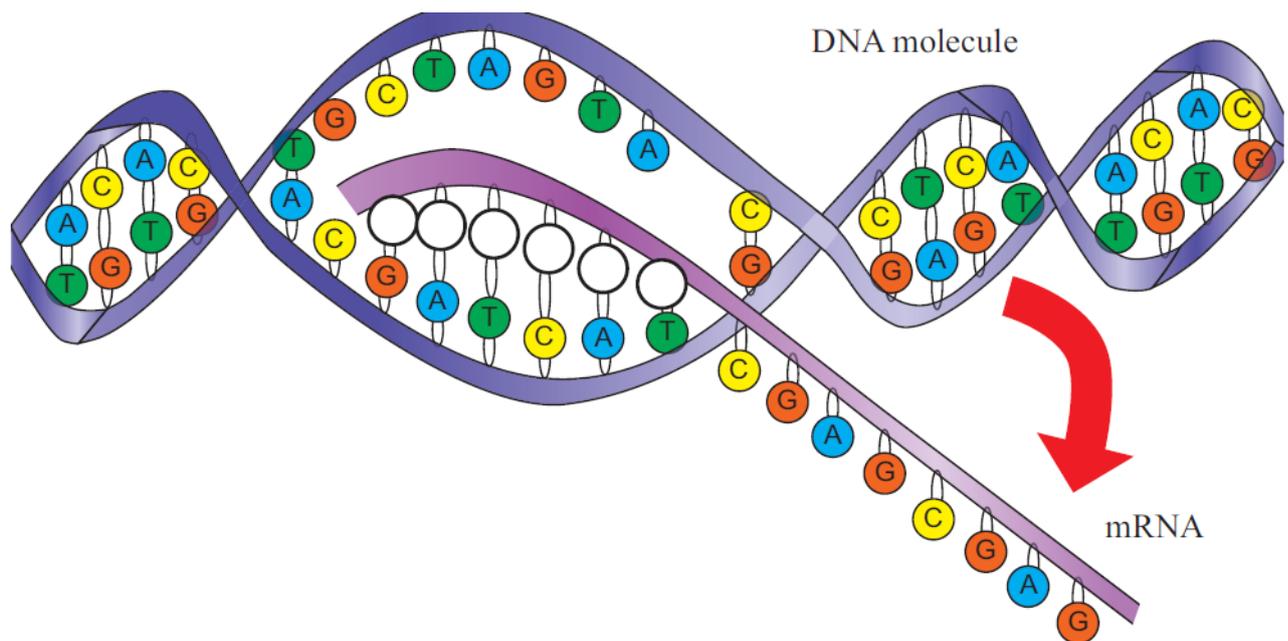
- a description of a triplet, codon, and anti-codon
- an explanation of what a start codon and a stop codon are
- a discussion of how triplets, codons, and anti-codons interact during transcription and translation to form a protein.

You may use diagrams in your answer.

(2014, 1)

(a) The diagram below shows the cell process, transcription.

On the diagram, fill in the missing bases on the mRNA strand.



(b) Protein synthesis involves two stages: transcription and translation.

Compare and contrast these two cell processes and their role in protein synthesis.

In your answer:

- explain the purpose and processes of transcription AND translation
- discuss the similarities and differences between transcription and translation.

You may use diagrams to support your answer.

(2013, 2)

The DNA sequence determines the structure of a protein and how that protein is produced.

TABLE OF mRNA CODONS

		SECOND CODON ELEMENT				
		U	C	A	G	
FIRST CODON ELEMENT	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	GLU	ARG	A
		LEU	PRO	GLU	ARG	G
	A	ILE	THR	ASPN	SER	U
		ILE	THR	ASPN	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

(a) Using the information provided above, complete the table below.

Note: In the table below, you need only to give one possible codon for each mRNA.

DNA				
mRNA				
Amino Acids	MET	GLU	TYR	STOP

Explain with an example from the table why there is more than one possible codon for the same amino acid.

(b) Discuss the major stages of protein synthesis.

In your answer, include each of the following:

- the role of the DNA template and coding strands
- RNA structure and function
- the relationship between codons AND anticodons
- the role of start AND stop codons
- the purpose of the ribosome.

(2012, 2)

Part of a sequence of mRNA is shown below.

- (a) Complete the DNA strands by filling in the missing bases, AND identify which strand is the DNA template, by circling the appropriate label.

DNA	T	A	C										Strand 1
DNA	A	T	G										Strand 2
mRNA	A	U	G	G	C	A	G	A	U	U	C	U	

- (b) With reference to the table below, explain what is meant by the term ‘redundancy due to degeneracy within the code’.

TABLE OF mRNA CODONS

		SECOND CODON ELEMENT					
		U	C	A	G		
FIRST CODON ELEMENT	U	PHE	SER	TYR	CYS	U	THIRD CODON ELEMENT
		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	GLU	ARG	A	
		LEU	PRO	GLU	ARG	G	
	A	ILE	THR	ASPN	SER	U	
		ILE	THR	ASPN	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) Discuss the formation of a functional protein, beginning with a completed mRNA strand.

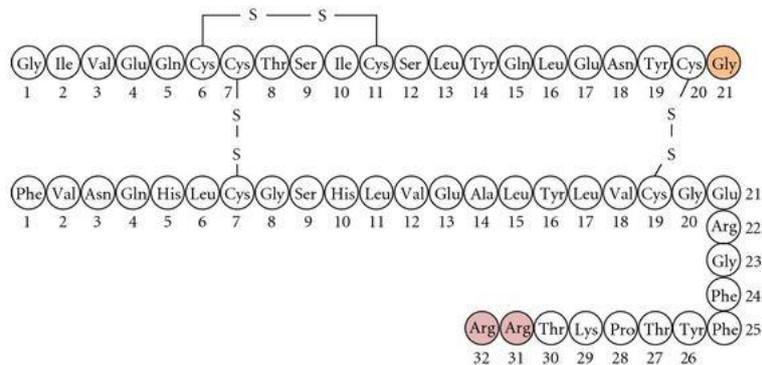
In your discussion, you should refer to each of the following:

- translation
- ribosomes
- tRNA
- codons anticodons
- start AND stop codons
- polypeptide chains.

The following questions were collated from the Level 3 AS 90715 since Protein Synthesis was examined there. Protein synthesis was not previously examined in a Level 2 AS.

(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 below.



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: 1 (a),(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

(2009: 1(b)-(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.

(2007:1(c))

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**.