THE INSTITUTE OF EDUCATION

Biology

Wesley Hammond

6th Year Leaving Certificate

Higher Level

2020-2021

Unit 2:

DNA and RNA

CONTENTS

What do you need to know about UNIT 2?

- Unit 2 is worth at least 40% of the Biology paper (can be worth more if experiments from this section are asked).
- Two short questions (10%) will be asked from unit 2.
- Two long question (30%) will be asked from unit 2.
- An experiment question (7.5%) can also be sometimes asked in section b of paper.

DNA and RNA

History of topic	
2004	60 marks
2005	20 marks
2006	30 marks
2007	60 marks
2008	30 marks
2010	42 marks
2011	30 marks
2012	9 marks
2013	20 marks
2014	36 marks
2015	52 marks
2017	36 marks
2018	9 marks
2019	40 marks

DNA and RNA

Structure of DNA

DNA = **d**eoxribo**n**ucleic **a**cid

- DNA is located inside the nucleus of a cell.
- DNA can fit into a nucleus as it can coil and fold.
- DNA has two strands.

NOTE: DNA is also found in the **mitochondria** and **chloroplast** of cells.

There are four bases used in DNA:

A = adenine

T = thymine

G = guanine

C = cytosine

What is meant by the term **complimentary base pairs?**

- These are **bases that match** (correspond) with each other.

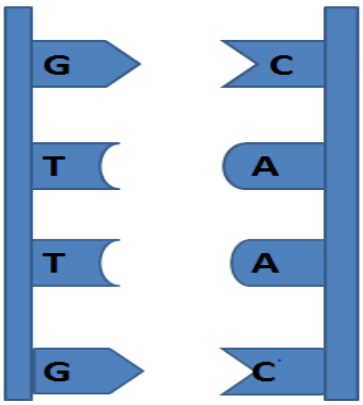
Structure of DNA

- Adenine joins with thymine

A ⟶ T

- Guanine joins with Cytosine

G ⟶ C

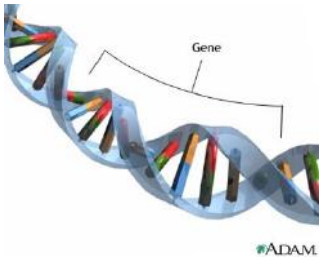


What shape does DNA have?

- DNA have a **double helix shape**

What is a gene?

- A gene is a **section of DNA** that has the code for the production of protein.



The Genetic code

- **What is the genetic code?** It is a **sequence of three bases** (codon or triplet) that represents a code for an amino acid.

- **How many common amino acids are used in the production of proteins**? 20

- A gene carries different codes to control the formation of the different amino acids.

Examples:

- A DNA triplet **CAA** is the code for the amino acid called **valine**
- A DNA triplet **CGA** is the triplet for an amino acid called **alanine.**

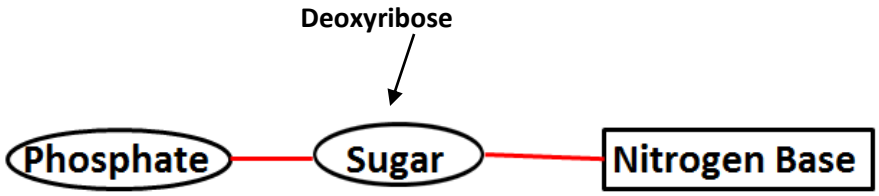
What is non – coding DNA?

- They **do not have a code** for the formation of a protein.
- Non-coding DNA is also known as **junk DNA**.

Detailed look at DNA

What is the structure of a nucleotide?

- DNA is made up of units called nucleotides.



Draw the four nucleotides in DNA:

Sugar is Deoxyribose = D

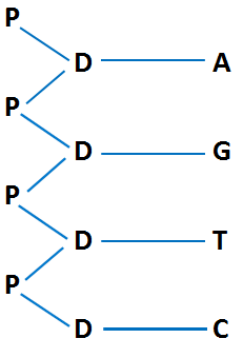
Phosphate group = P

Nitrogen base = A or G or T or T

What is a polynucleotide?

- It is many nucleotides joined together.

Structure of a polynucleotide



P = Phosphate

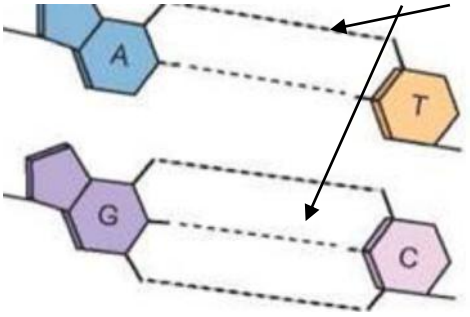
D = deoxyribose (sugar)

Draw a polynucleotide:

What holds bases together?

- Bases are held together by a **hydrogen bond**.
- Adenine and thymine form **two** weak hydrogen bonds.
- Guanine and cytosine form **three** hydrogen bonds.

Hydrogen bonds



What are purines and pyrimidines?

- There are four nitrogen bases, two are known as **purines** and two as **pyrimidines.**
- Two **purine** bases are (double ringed molecules): adenine (A) and guanine (G)
- Two p**y**rimidine bases are (single ringed molecules): th**y**mine (T) and c**y**tosine (C)

What scientists discovered the shape and structure of DNA?

- Frances **Crick** and James **Watson**

Structure of RNA:

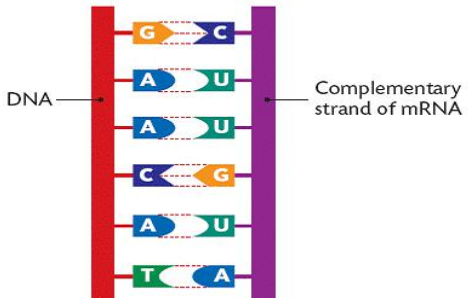
RNA = **r**ibo**n**ucleic **a**cid

- RNA also consist of four bases
- RNA contains the base **uracil instead of thymine**.
- The bases in RNA pair up with those in a section of DNA.
- RNA is a **single stranded** molecule.

What are the four bases:

1) Adenine (A)
2) **Uracil (U)**
3) Guanine (G)
4) Cytosine (C)

Base pairing between DNA and RNA



Draw the complimentary RNA strand

Example: If DNA has sequence **GCAATC** along one strand, then the RNA will have the sequence **CGUUAG**

Differences between DNA and RNA

DNA	RNA
Has the bases ATGC	Has the bases AUGC
Double stranded	Single stranded
Sugar = deoxyribose	Sugar = ribose
Found in the nucleus	Found in nucleus, cytoplasm, ribosome

NOTE: DNA is also found in the mitochondria and the chloroplast (this is known as **non-nuclear DNA**.

Protein Synthesis (the making of protein)

- Genes are used to produce different proteins. A gene is a **section of DNA** that has the code for the production of protein.

- The major steps involved in protein synthesis include:

1) **Transcription** = making of mRNA from DNA (occurs in **nucleus**)

2) **Translation** = making of protein depending on the mRNA code (occurs in the **ribosome**)

Three types of RNA involved in production of protein:

A. messenger RNA (mRNA)

B. transfer RNA (tRNA)

C. ribosomal RNA (rRNA)

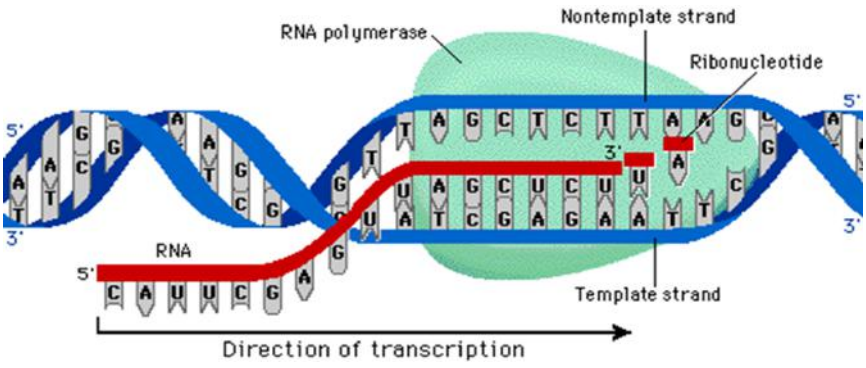
- Remember: all produced in the nucleus!

Steps involved in transcription:

1) Enzymes start to unwind the DNA double helix in the nucleus.

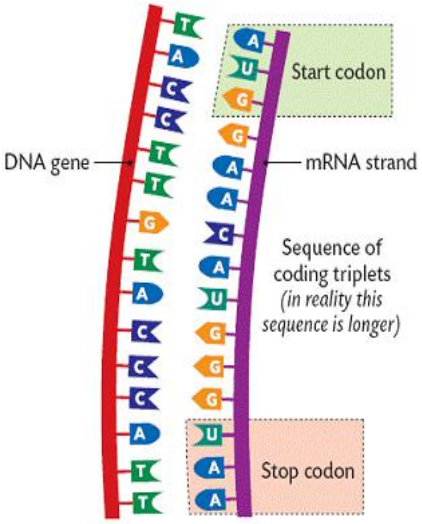
2) Complimentary RNA bases join to the exposed DNA strand to form mRNA **(transcription)**.

3) The enzyme **RNA polymerase** joins the RNA bases together to **form mRNA** (messenger RNA)



NOTE: **Each mRNA strand has**:

i) a **start** codon
ii) a series of codons represent different amino acids
iii) a **stop** codon



NOTE: start codon and stop codon are not involved in protein production.

Steps involved in translation:

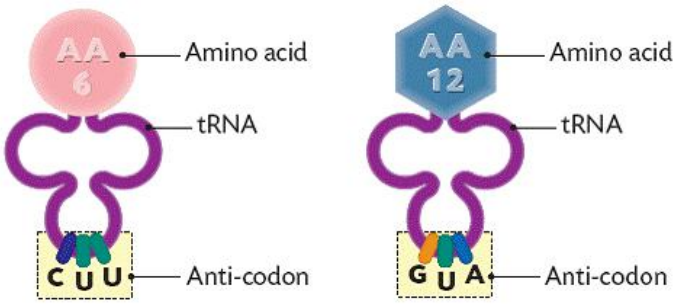
5) mRNA moves from the nucleus to the cytoplasm

6) rRNA (ribosomal RNA) are found in the ribosome

7) **mRNA** then moves into the ribosome and forms a **weak bond** with the **rRNA** (rRNA holds the mRNA in place in ribosome).

NOTE: ribosome is the site for protein synthesis

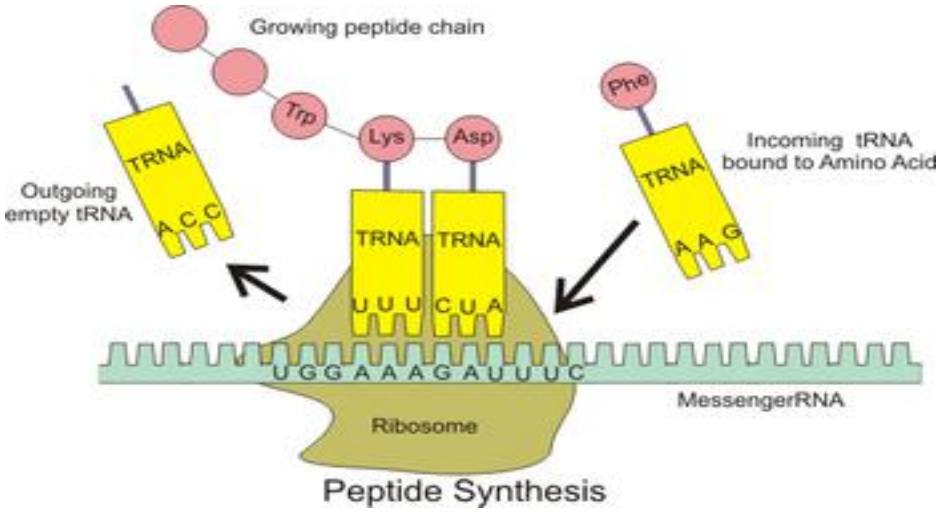
8) **tRNA** (transfer RNA) is found in the cytoplasm.
- tRNA contains an **anticodon attached to an amino acid**.



NOTE: an anticodon is a sequence of three bases on tRNA

9) tRNA is attracted to the mRNA in the ribosome. The anticodon on the **tRNA compliments** the codon on **the mRNA**.

10) As the tRNA attach to the mRNA in the ribosome, it also brings with it an **amino acid**.



11) As the tRNA continue to enter the ribosome, the **amino acids detach from the tRNA** and bond together to form a new protein.

12) tRNA leave the ribosome without any amino acids and pull with it the mRNA strand out of the ribosome.

13) The process stops once it has reached the stop codon. A new protein has been produced and **becomes functional when it folds**.

Review

Functions of RNA:

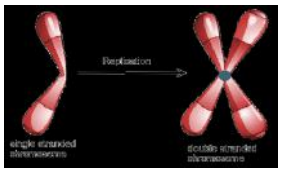
- **mRNA (messenger RNA)** – gets code from the DNA in nucleus/ then carries this code to the ribosome.
- **rRNA (ribosomal RNA)** – binds (or holds) the mRNA in place in the ribosome.
- **tRNA (transfer RNA)** – carries an amino acid to the ribosome/ it binds with the mRNA/ places amino acid in sequence.

NOTE:

- If a DNA sequence in a gene is not correct, the amino acids that join together will not form the correct protein (e.g cystic fibrosis)

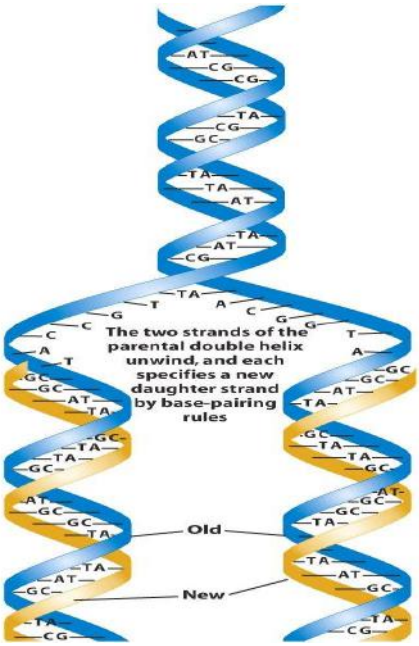
DNA replication

- When **mitosis** occurs, one cell divides into two identical daughter cells.
- DNA replication occurs so there is an **exact copy of the DNA** for mitosis to occur.
- Takes place during the **interphase** of a cell.



How does DNA replication occur?

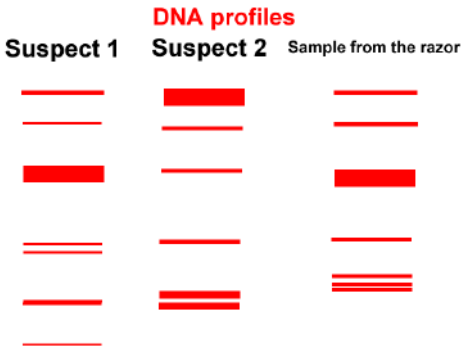
- Enzyme breaks the hydrogen bond between the base pairs. The double helix **unwinds.**
- Other DNA bases now enter the nucleus and join with the exposed DNA strand.
- **Two new strands of DNA** are formed that are identical to the original strand.



DNA Profiling

What is DNA Profiling?

- It is a method of making a **unique pattern of bands** from the DNA of a person which is then used to tell the difference of that DNA from other DNA.



Method of DNA profiling

1) DNA is released:

- Dna is released by the breaking down of the cell.

2) DNA is cut into fragments:

- **DNA is cut into fragments** using enzymes **(restriction enzymes)** depending on the sequence of bases.

- The section of DNA bases cut will be of different lengths because of the different distances between the base sequences.

3) **The fragments are separated**:

- **Fragments of DNA are separated based on their size**.

- They are separated by a process called **gel electrophoresis**. An electric current is passed through the gel which allows bands of small DNA fragments to be separated from bands of larger DNA fragments.

NOTE: The smaller DNA fragments move quicker through the gel.

4) Patterns are compared:

- If two different DNA samples are the same, then the two samples must have come from the same person.

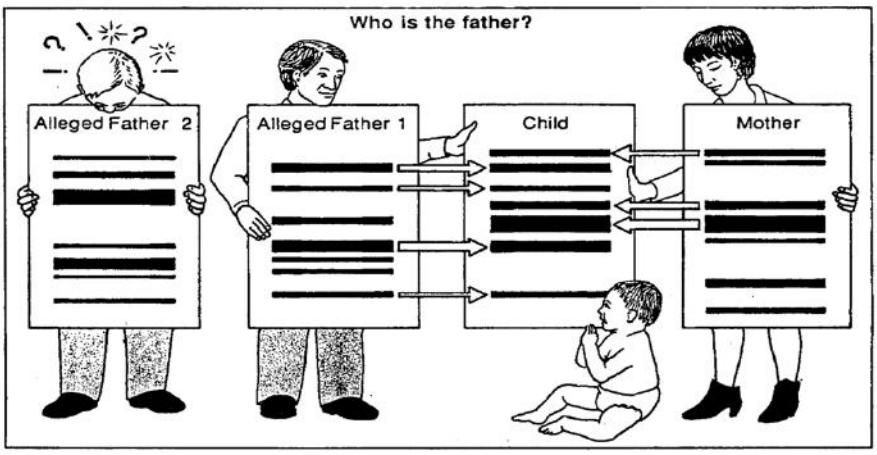
Applications of DNA profiles (DNA fingerprints)

Solving Crimes:

- If a suspects DNA profile is compared to a victims DNA profile in a crime, and they are similar, then it can be said that this person was present at the crime scene.

Medical (e.g maternity/ paternity tests)

- DNA profiles can be used to determine whether a person is the parent of a child (e.g financial inheritance cases)



Genetic screening

- Genetic screening is **testing DNA** for the presence or absence of an **altered gene**.
- Genes can be altered by mutations.
- Altered genes do not have the correct code for the production of protein.

NOTE: genetic disorders caused by altered genes include albinism, cystic fibrosis.

Where is genetic screening used?

1) **Adult screening:**

- Carried out on people who do not have a genetic disorder but may carry altered genes.
- Tells them the chances if their children will have the genetic disease.

  Examples: carriers of sickle cell anaemia and cystic fibrosis

2) **Foetal screening:**

- Cells can be removed from the placenta of a foetus.
- Child can be tested for genetic disorders

What Ethical issues does genetic screening bring?

- Mothers may terminate a pregnancy if they find out their unborn child has a genetic disorder.

Experiment: To isolate DNA from tissue of a plant.

1) Chop up a kiwi or an onion (this **increases the surface area** for the washing up liquid to act on).

2) Add **sodium chloride (salt)** to **washing up liquid** in distilled water.

NOTE: washing up liquid causes the **cell and nuclear membranes** to break, which releases DNA from the cells.

NOTE: The salt causes the **DNA to clump** together.

3) Add the kiwi to the washing up liquid and salt solution.

4) Place this solution in a **water bath at 60°C for 15 minutes** (denatures the enzymes which stops the DNA being digested).

NOTE: should not be left more than 15 minutes as the DNA would break down.

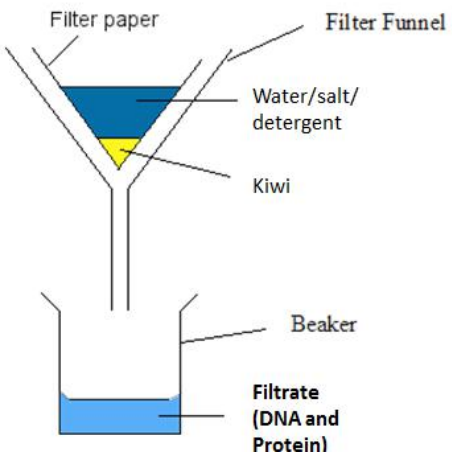
5) Place the solution in a **water bath that is ice cold** for 5 minutes (the breakdown of DNA is slowed down).

6) Place the solution into a blender for **3 seconds** (the **cell walls are broken down** to release DNA).

NOTE: If left any longer than 3 seconds will break down the DNA itself.

7) Filter the solution using coffee filter paper (using normal filter paper would slow down the process).

NOTE: the DNA and protein pass through the filter paper.



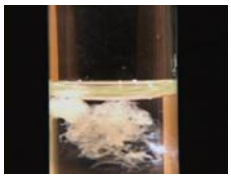
8) Using a **<u>syringe</u>** place some of the filtered solution into a boiling tube.

9) Add **<u>protease enzyme</u>** which helps break down the proteins around the DNA.

10) Add **<u>ice cold ethanol</u>** slowly down the side of the boiling tube.

<u>NOTE</u>: Alcohol helps remove water from DNA which causes the DNA to float to top.

<u>NOTE</u>: DNA forms white threads.



11) Using a glass rod, DNA should attach to it as it is twisted.

Important Definitions

- A **triplet (codon)** is a sequence of three bases.

- The **genetic code** is a **sequence of three bases** (codon or triplet) that represents a code for an amino acid.

- A **gene** is a **section of DNA** that has the code for the production of protein.
- **Complementary bases** are when each base has a different corresponding base (or bases that match each other).
- A **nucleotide** consists of a phosphate group, deoxyribose (sugar) and a nitrogen base.
- A **polynucleotide** are many nucleotides joined together.
- **Anti codon** is a sequence of three bases on the tRNA that complement three bases on the mRNA.
- **DNA profiling** makes a pattern of DNA bands of a person, which can be used to distinguish that DNA from other DNA.

- **Restriction enzymes** are used to cut the DNA into different fragments.

- **Genetic screening** is the testing of DNA for an altered gene.
- **Protein synthesis** is the making of a protein.

- **Translation** is the making of a protein using the mRNA code.

- **Transcription** is the making of mRNA from DNA.
- **Purines** are double ringed molecules and include adenine and guanine.
- **Pyrimidines** are single ringed molecules which include cytosine and thymine.
- **Non coding DNA**: They **do not have a code** for the formation of a protein. Non-coding DNA is also known as **junk DNA**.

Exam Questions

Exam Paper 2019, Question 7:

(ii) When extracting DNA from plant tissue, why did you use:

1.	Washing-up liquid?
2.	Freezer-cold ethanol?

Exam Paper 2019, Question

(a) (i) Name the sugar present in DNA.
(ii) Other than the sugar, give two structural differences between DNA and RNA.

(9)

(b) Protein synthesis is a complex process, involving both transcription and translation, that occurs in all cells.
(i) Where does transcription occur in animal and plant cells?
(ii) Where precisely in the cell does translation occur?
(iii) Name the **three** types of RNA involved in protein synthesis.
(iv) Describe the events that occur during translation, leading to the formation of a functional protein.

(27)

Exam Paper 2018, Question

(a) Most organisms contain both nucleic acids, RNA and DNA.

(i) Name the biologically active entities, each of which contains only one type of nucleic acid.

(ii) Name **two** locations in eukaryotic cells where RNA but no DNA is found.

(9)

Exam Paper 2017, Question 12:

12. (a) Give a brief account of how you would produce a DNA profile. **(9)**

(b) (i) In the context of natural selection, explain how numbers in a population remain relatively constant despite the production of many offspring.

(ii) The son of a haemophiliac father was not haemophiliac. Explain in detail how this situation might have arisen.

(27)

(c) DNA contains the genetic code for the formation of all proteins.

(i) Name the **two** purine bases in DNA.

(ii) Describe fully the roles played in protein synthesis by the three different types of RNA.

(iii) Once a protein has been synthesised, a final step is required for it to become fully functional. What is this step?

(24)

Solutions 2017, Question 12:

12. (a) *DNA profile:*

(DNA) cut with (restriction) enzymes	**3**
Fragments separated	**3**
According to size **or** by electrophoresis (or described)	**3**

(c) **3(4) + 2(3) + 3(2)**

(i) *Both DNA purines:*

*Adenine

*Guanine

(ii) *Roles of different RNAs in protein synthesis:*

Messenger RNA (mRNA) gets code from DNA

Messenger RNA (mRNA) carries code to ribosome

Ribosomal RNA (rRNA) forms the ribosome (ribosomal subunits) **or** binds (or holds) mRNA in place

Transfer RNA (tRNA) transfers amino acids to mRNA (or to ribosome)/ binds to (complementary) mRNA codon/ places amino acids in sequence **or** translates mRNA code to amino acid sequence

Any two

(iii) *Final step for functional protein:*

Folding (or described)

Exam Paper 2015, Question 10b:

(b) Write notes on each of the following topics in relation to nucleic acids. In each case your notes should contain three points. Do not give diagrams in your answers.

(i) Complementary base pairs.

(ii) Codons.

(iii) Transcription. **(27)**

Solutions 2015, Question 10b:

(i) (Two bases joined by) hydrogen bonds / purine with pyrimidine / Cytosine with Guanine / Adenine with Thymine in DNA / Adenine with Uracil in RNA **or** Thymine replaced by Uracil in RNA **3(3)**

(ii) Sequence(s) of three bases / on DNA / on mRNA **or** on tRNA / (each codon) codes for one amino acid / that codes for a start (or stop) **3(3)**

(iii) mRNA is formed / using a (single) strand of DNA / (DNA acts) as a template (or described) / in nucleus / (catalysed by) RNA polymerase **3(3)**

Exam Paper 2014, Question 10b:

(b) Last year it was discovered, by DNA analysis, that meat products labelled as beef contained meat from other animals, particularly horses and pigs.

(i) Name the biomolecule that is the major component of meat.

(ii) Where in a cell are these biomolecules manufactured?

(iii) Name the molecule, formed from DNA, which carries the instruction to manufacture these biomolecules.

(iv) Name **and** outline the procedure used for analysing the DNA samples that revealed the presence of horse meat in products labelled as beef.

(v) Would the result obtained from the procedure referred to in (iv) be the same if the beef were contaminated with pig meat? Explain your answer.

(27)

Solutions 2014, Question 10b:

(b)	(i)	*Protein	**3**
	(ii)	Ribosomes	**3**
	(iii)	*mRNA	**3**
	(iv)	(DNA) profiling	**3**
		Cut (DNA into fragments) / with (restriction) enzymes / separate fragments / on basis of size / analyse results (or explained)	**3(3)**
	(v)	No, because pig DNA is not the same as horse DNA **OR** Yes, because not all the DNA is beef DNA	**6, 3, 0**

Exam paper 2013 Question 6:

(a) (i) In DNA, nitrogenous bases occur in complementary pairs. Explain the term *complementary* as used here.

_____

(ii) In each case, name the complementary base **in RNA** for:

1. Adenine _____
2. Cytosine _____

(iii) Name a carbohydrate that is a component of nucleotides.

_____

(iv) Name a component of a nucleotide that is neither a carbohydrate nor a nitrogenous base.

_____

(b) (i) What does the 'm' stand for in mRNA? _____

(ii) Give **one** difference between RNA and DNA, other than the nitrogenous bases.

_____

(iii) Give the role of the enzyme RNA polymerase.

_____

Solutions 2013 Question 6:

6.			1 + 1 + 8 + 6 + 4(1)
(a)	(i)		Each base has a (different) corresponding (or matching) (base)
	(ii)	1.	Uracil **or** U
		2.	Guanine **or** G
	(iii)		Ribose **or** deoxyribose
	(iv)		Phosphate (group) **or** P
(b)	(i)		Messenger
	(ii)		RNA has ribose **or** RNA is single stranded **or** DNA has deoxyribose **or** DNA is double stranded
	(iii)		Joins nucleotides together (to give mRNA product) **or** to make RNA

Exam Paper 2011 Question 9:

(a) (i) How are the two strands of a DNA molecule joined together? _____

(ii) What is 'junk' DNA? _____

(b) Answer the following questions by referring to the procedures that you used to isolate DNA from a plant tissue.

(i) Having obtained a plant tissue e.g. onion,

1. What was the first procedure that you followed?

_____

2. What was the reason for that procedure?

_____

(ii) Washing-up liquid is then used in the isolation. Give a reason for its use.

_____

(iii) Salt (sodium chloride) is also used in the isolation. Give a reason for its use.

_____

(iv) 1. What is a protease?

_____

2. Why is a protease necessary when isolating DNA?

_____

(v) The final stage of the isolation involves the use of freezer-cold ethanol.

1. Describe how it is used. _____

2. For what purpose is it used? _____

Solutions 2011 Question9:

9.	(a)	(i)	Hydrogen bonds	3
		(ii)	Non-coding (or described)	3
	(b)	(i)	1. Chop 2. To disrupt structure (or described) or to increase surface area	3 3
		(ii)	To disrupt membranes	3
		(iii)	To clump the DNA (or described) or to protect DNA from other positive ions	3
		(iv)	1. An enzyme that digests protein 2. Because DNA is combined with protein	3 3
		(v)	1. Added down the side of the test tube or added slowly 2. To bring the DNA out of solution	3 3

Exam Paper 2010 Question 10:

Part (a) deals with DNA structure and replication.

a)

i) Name the base in DNA that pairs with cytosine:

_____

ii) What are the two main events in the replication of DNA:

_____

_____

Part (b) deals with protein synthesis.

b)

i) Explain the terms transcription and translation:

_____

_____

_____

_____

ii) In what structures in the cell does translation occur:

_____

_____

iii) How many bases in sequence make up a codon in mRNA:

_____

iv) Each mRNA codon specifies one of three possible outcomes during protein synthesis. Name these three possible outcomes:

_____

_____

_____

_____

v) What does the letter 't' stand for in tRNA:

_____

vi) During translation one end of a tRNA molecule attaches to an mRNA codon. What is usually attached to the other end of the tRNA molecule:

_____

_____

Solutions 2010 Question 10a, b:

(a)	(i)	*Guanine	3
	(ii)	(DNA) opens (or unzips) / new strands (made)	2(3)
(b)	(i)	*Transcription*: making of (m)RNA using DNA (template) *Translation*: making a protein using (m)RNA (code)	3 3
	(ii)	*Ribosome(s)	3
	(iii)	*Three	3
	(iv)	Start; Adding an amino acid; Stop	3 3 3
	(v)	*Transfer	3
	(vi)	*An amino acid	3

Exam paper 2008 Questions 14b:

b)

i) DNA is made of units called nucleotides. Draw a labelled diagram of a nucleotide to show its three constituent parts:

ii)Which of the labelled parts in your diagram in (i) may vary from nucleotide to nucleotide:

_____

_____

iii)The genetic code is contained within the DNA of chromosomes. Briefly describe the nature of this code:

_____

_____

_____

iv)What is meant by non-coding DNA:

_____

_____

v)Give one structural difference between DNA and RNA:

_____

_____

vi) Name a cell organelle, apart from the nucleus, in which DNA is found:

_____

Solutions 2008 Question 14b:

(b)	(i)	Diagram labels: deoxyribose **or** ribose, phosphate, base **or** named base	3 3(2)
	(ii)	Base **or** named base	3
	(iii)	three bases (triplet **or** codon) / in sequence / (codes for) one amino acid /(base or triplet or codon) sequence / codes for protein	3(3)
	(iv)	does not code for a protein **or** for RNA [*allow* not part of the genetic code **or** explained]	3
	(v)	(DNA) contains thymine **or** RNA contains uracil	3
	(vi)	Mitochondrion **or** chloroplast	3

Exam Paper 2005 Question 8:

(a) Explain each of the following terms in relation to DNA.

(i) Replication .....

.....

(ii) Transcription .....

.....

(b) As part of your practical activities you extracted DNA from a plant tissue. Answer the following questions in relation to this experiment.

(i) What plant did you use?.....

(ii) It is usual to chop the tissue and place it in a blender. Suggest a reason for this.

.....

.....

.....

.....

(iii) For how long should the blender be allowed to run? .....

.....

(iv) Washing-up liquid is normally used in this experiment. What is its function?

.....

.....

.....

.....

(v) Sodium chloride (salt) is also used. Explain why.....

.....

.....

.....

(vi) What is a protease enzyme? .....

(vii) Why is a protease enzyme used in this experiment? .....

.....

.....

.....

(viii) The final separation of the DNA involves the use of alcohol (ethanol). Under what condition is the alcohol used? .....

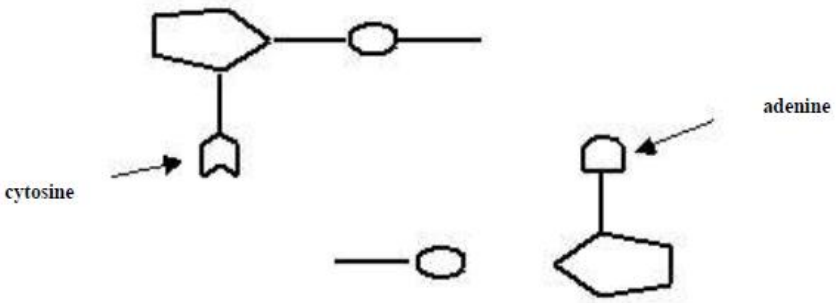
.....

Solutions 2005 Question 8:

8.	**(a)**	**(i)**	Making a copy	**3**
		(ii)	(Matching) RNA production (notion of both DNA and RNA must be given)	**3**
	(b)	**(i)**	Name of plant	**3**
		(ii)	Break up of cell (walls) or release of cytoplasm	**3**
		(iii)	A few seconds only (max 6 secs)	**3**
		(iv)	To break down membrane(s) or membrane components	**3**
		(v)	Clumps (protects) DNA / to remove protein / separates DNA / separates protein	**3**
		(vi)	Breaks down (acts on) protein	**3**
		(vii)	Proteins are associated with DNA (histones or chromosomes)	**3**
		(viii)	(Ice) cold	**3**

Exam paper 2004 Question 13

(a) Copy the diagram into your answer book and then complete it to show the complementary base pairs of the DNA molecule. Label all parts not already labelled. **(9)**



(b) The genetic code incorporated into the DNA molecule finds its expression in part in the formation of protein. This formation requires the involvement of a number of RNA molecules. List these RNA molecules and briefly describe the role of each of them. **(24)**

Solutions 2004 Question 13 a, b:

13.	(a)		Completed **diagram** showing two additional sugar molecules and two more bases **diagram completed correctly or** shapes of bases **or** show bonding **new bases named and matched** **deoxyribose or phosphate labelled**	 **3, 0** **3, 0** **3, 0**
	(b)		mRNA(messenger RNA) rRNA (ribosomal RNA) tRNA (transfer RNA) **Functions:** **mRNA:** mRNA formed to match DNA (or transcription or explained) / leaves nucleus **or** into cytoplasm / (carries instructions) to ribosomes **or** for translation **rRNA:** rRNA binds (holds) mRNA in place / for translation (**or** explained) / structure of ribosome **tRNA:** tRNA carries an amino acid / complementary to mRNA / to ribosomes ***any five functions*** [***must be at least one point from each RNA type***]	**3** **3** **3** **5(3)**

Do you know	Tick
To know what DNA is an abbreviation for	
State the location of DNA in a cell apart from the nucleus	
To name the four bases that make up DNA	
To name the bases that are complimentary to each other	
To name the shape of a DNA stand	
Define the term gene	
To write a short note on the genetic code	
To describe a triplet/ codon	
To define non-coding DNA (junk DNA)	
To describe, draw and label the structure of a nucleotide	
To name the component of a nucleotide that is a carbohydrate	
To name the component of a nucleotide that can vary	
To describe, draw and label the structure of a polynucleotide	
To name the bond that holds bases together	
To know how many hydrogen bonds that hold adenine and thymine together	
To know how many hydrogen bonds that hold guanine and cytosine together	
To list the pyrimidine bases and purine bases	
To name the scientist who discovered shape and structure of DNA	
To know what RNA is an abbreviation for	
State the location of where RNA can be found in a cell	
To name the four bases found in RNA	
To be able to distinguish between the structure of RNA and DNA	
To describe what is meant by non-nuclear DNA	
For protein synthesis define transcription and state location where it occurs in cell	
To describe the steps involved in transcription	
For protein synthesis define translation and state location where it occurs in cell	
To name the three types of RNA	
To state the functions of all three types of RNA	
To state the three possible outcomes of codons	
State how a protein becomes functional once it has been formed in ribosome	
To describe the steps involved in DNA replication	
Name the stage of the cell cycle in which DNA replication occurs	
Define the term DNA profiling	
To describe method involved in DNA profiling	
To name two applications of DNA profiling	
Define the term genetic screening and where it is used	
To isolate DNA from plant tissue state what plant you used	
To isolate DNA from plant tissue state why you cut the plant into smaller pieces	
To isolate DNA from plant tissue state why you used salt	

To isolate DNA from plant tissue state why you added washing up liquid	
To isolate DNA from plant tissue state why you used a water bath at 60^0C	
To isolate DNA from plant tissue state why you used a water bath that is ice cold	
To isolate DNA from plant tissue state why you used a blender	
To isolate DNA from plant tissue state why you used protease enzyme	
To isolate DNA from plant tissue state why you used ice cold ethanol	
To isolate DNA from plant tissue state the appearance of the DNA at the end of experiment	