VCE BIOLOGY UNIT 3 & 4
Australian Curriculum

WORKBOOK

Biology

TOPICS

UNIT 3: HOW DO CELLS MAINTAIN LIFE?

Area of Study 1: What is the role of nucleic acids and proteins in maintaining life?

Area of Study 2: How are biochemical pathways regulated?

UNIT 4: HOW DOES LIFE CHANGE AND RESPOND TO CHALLENGES?

Area of Study 1: How do organisms respond to pathogens?

Area of Study 2: How are species related over time?

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Supporting Teachers of Science
Advancing Science Education

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Area of Study 1: How do organisms respond to pathogens?

Area of Study 2: How are species related over time?

About this book

The Fourth Edition of the SASTA Stage 1 Biology Workbook continues to set the benchmark for excellence in biology education, offering students a clear, engaging, and comprehensive resource that enhances learning and supports academic success. Building on the strengths of previous editions, this edition introduces new artwork, extended explanations, and additional questions further to refine students' understanding of key biological concepts.

This workbook remains fully aligned with the Stage 1 Biology curriculum in South Australia, providing a structured and highly accessible text that balances concise explanations with deep conceptual understanding. With an emphasis on application over rote memorisation, students are encouraged to develop critical thinking and problem-solving skills through well-structured learning outcomes, contextual examples, and thought-provoking questions.

The Fourth Edition includes expanded content, featuring updated information and extended explanations to deepen understanding, new illustrations that clarify complex concepts, and additional chapter questions designed to challenge students and reinforce key learning objectives.

The workbook continues to be authored and reviewed by experienced biology educators, ensuring the content is scientifically accurate, pedagogically sound, and visually engaging. With its student-friendly writing style, well-structured assessments, and comprehensive solutions, this workbook provides students with the tools they need to learn efficiently, retain key concepts, and excel in their studies.

SASTA remains committed to continuous improvement, and we extend our gratitude to the educators and students who have provided valuable feedback. Your insights have played a crucial role in refining this edition. We welcome further suggestions to ensure that future editions continue to support student success.

We wish you all the best in Stage 1 Biology and remind you that our Stage 2 Biology Workbook is also available for students continuing their studies.

UNIT 3:
How do cells maintain life?

AREA OF STUDY 1: What is the role of nucleic acids and proteins in maintaining life?

3.1 The Relationship Between Nucleic Acids and Proteins

3.1: The Relationship between Nucleic acids and Proteins

Nucleic acids as information molecules that encode instructions for the synthesis of proteins: the structure of DNA, the three main forms of RNA (mRNA, rRNA and tRNA) and a comparison of their respective nucleotides.

Living things rely on precise instructions to build and maintain the complex structures and functions necessary for life. These instructions are encoded in **nucleic acids**, a class of macromolecules in cells that store, transmit, and regulate genetic information. Two key types of nucleic acids, **deoxyribonucleic acid (DNA)** and **ribonucleic acid (RNA)**, work together to direct the synthesis of proteins, which are essential for cellular structure and function.

The Structure of DNA

DNA is a **nucleic acid**, a macromolecule comprised of polymers called **polynucleotides**. As shown in **Figure 1.01**, a polynucleotide consists of repeating monomers called **nucleotides**, each containing a nitrogenous (nitrogen-containing) base, a sugar, and a phosphate group (**Figure 1.01**). There are four nitrogenous bases found in DNA, and each is represented by the first letter of its name: **thymine (T), cytosine (C), adenine (A) and guanine (G).** The nitrogenous bases are chemically bonded to a five-carbon sugar called **deoxyribose**, which is bonded to a phosphate group. The phosphate group links the sugars of two nucleotides in a polynucleotide, resulting in a repeating sugar-phosphate pattern called the **sugar-phosphate backbone** (**Figure 1.01**). The deoxyribose sugar contains five carbon atoms labelled 1' to 5' (pronounced: "five-prime"). The 5' carbon is bonded to the phosphate group of the same nucleotide, and the 3' carbon is bonded to the phosphate group of the next nucleotide in the polynucleotide. This specific linkage results in a directional structure, which is critical for DNA replication and transcription, ensuring that genetic information is copied and processed accurately. **Figure 1.01** shows the positions of the 3' and 5' carbon atoms in the sugar-phosphate backbone of the DNA molecule.

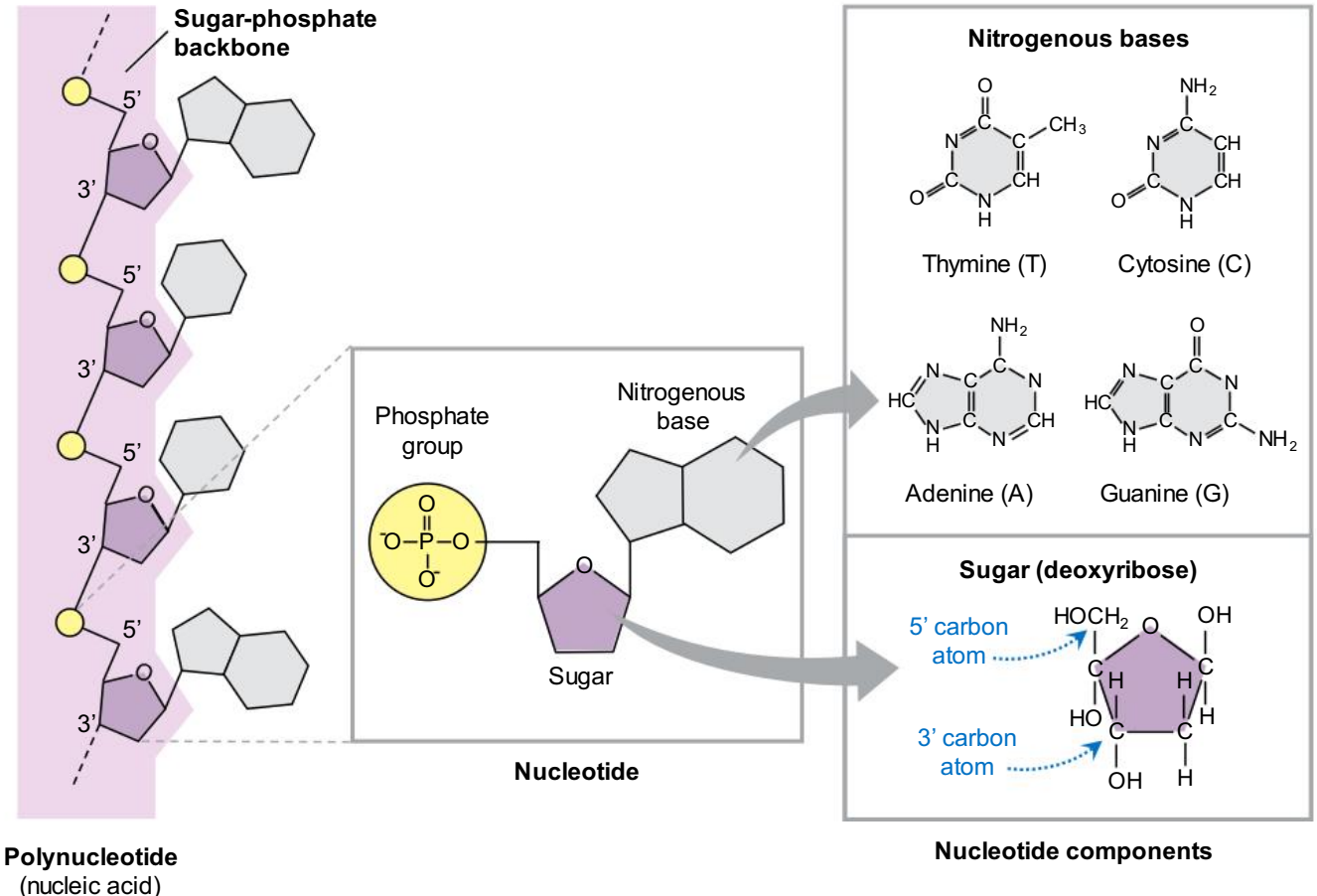


Figure 1.01: The structure of DNA

A DNA molecule has two polynucleotides strands that wind around an imaginary axis, forming a shape called a **double helix** (Figure 1.02). The two sugar-phosphate backbones run in opposite directions like a divided highway, an arrangement referred to as **antiparallel**. This orientation is crucial for DNA replication and enzymatic processes, as enzymes such as DNA polymerase function in a 5' to 3' direction. The sugar-phosphate backbones are on the outside of the helix, and the nitrogenous bases are paired in the interior of the helix through **hydrogen bonds**, forming a complementary base-pairing system. These weak electrostatic forces provide stability to the helix while allowing it to separate easily during DNA replication and transcription (Figure 1.02). Only certain bases in the double helix are compatible with each other. For example, Adenine (A) in one strand always pairs with thymine (T) in the other, and guanine (G) pairs with cytosine (C).

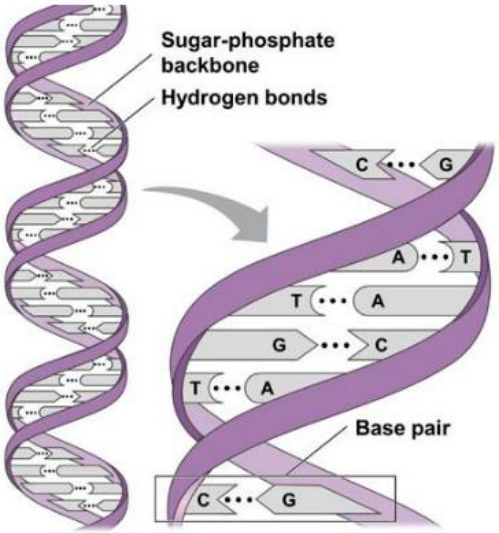


Figure 1.02: DNA double helix.

Chromosomes

Most DNA molecules are very long, containing thousands or even millions of base pairs. For this reason, cells arrange DNA molecules into one or more **chromosomes**, highly condensed structures composed of a single DNA molecule and associated proteins. In eukaryotes, each cell contains two or more linear chromosomes housed in the cell nucleus. Each eukaryotic chromosome contains **chromatin**, a mixture containing one long DNA molecule bound to proteins (Figure 1.03). Among the proteins bound to DNA in eukaryotes are **histones** (Figure 1.03), small round proteins that help coil the DNA molecule, reducing its length and allowing it to fit into the nucleus. When a eukaryotic cell is not dividing, the chromatin is relaxed, and the chromosomes are observed under an optical microscope as a spread-out mass, indistinguishable from one another. However, as a cell prepares to divide, the chromatin condenses, and the chromosomes become thick enough to be distinguished from one another under an optical microscope. In addition, each eukaryotic species has a characteristic number of chromosomes. For example, a typical human body cell has 46 chromosomes in its nucleus, whereas a fruit fly body cell has only eight chromosomes. In contrast, prokaryotes each contain a single circular chromosome located in the **cytosol**, the fluid which fills the cell's cytoplasm. In prokaryotes, the cytosol region containing the chromosome is called the **nucleoid**. Prokaryotic chromosomes are composed of a single DNA molecule, but each is unbound and is not associated with proteins that regulate its length (Figure 1.04). In addition, the mitochondria and chloroplasts of eukaryotes also contain circular chromosomes, a reflection of their evolutionary past as free-living prokaryotes.

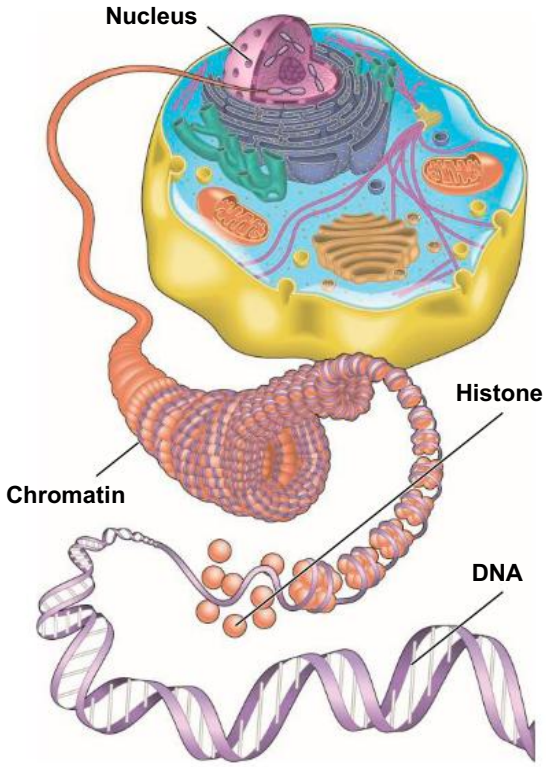


Figure 1.03: Chromosome structure eukaryotes

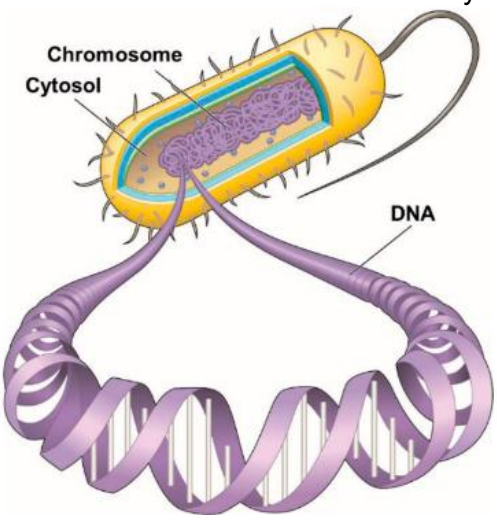


Figure 1.04: Chromosome structure prokaryotes

DNA Replication

DNA is the genetic material that organisms inherit from their parents. When a cell reproduces by dividing, its one or more DNA molecules are copied and passed along from one generation of cells, called **parent cells**, to the next, called **daughter cells**, making them genetically identical. This transmission of genetic information from parent to daughter cell depends on the structure and replication of DNA.

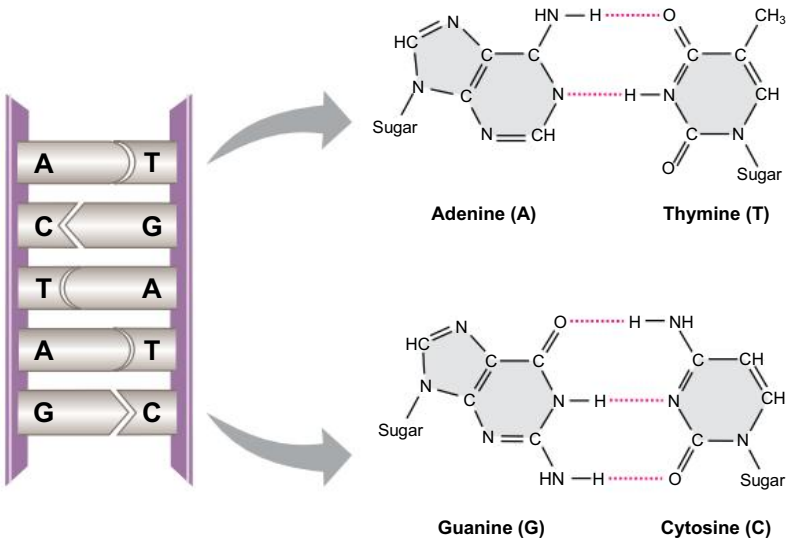


Figure 1.05: DNA base-pairing rules in DNA.

A DNA molecule is composed of two polynucleotide strands that form a double helix. The strands run antiparallel and are held together by hydrogen bonds between base pairs. In base-pairing, only certain bases in the double helix are compatible with each other due to the positions of their atoms. For example, guanine (G) in one strand always pairs with cytosine (C) in the other, and adenine (A) pairs with thymine (T), as depicted in **Figure 1.05**. These base-pairing rules are universal and allow us to predict the sequence of bases along one strand of the double helix when we know the sequence of bases along the other strand. For example, if one strand has the base sequence –ACTAG–, the same stretch of the other strand must have the sequence –TGATC–. This is because the two strands of the double helix are **complementary**, meaning each is the predictable counterpart of the other. This feature of DNA makes it possible to generate two identical copies of each DNA molecule in a cell preparing to divide.

Before a parent cell divides into daughter cells, its one or more chromosomes are copied, so the daughter cells each have a complete set of genetic information that programs a cell's activities. The process by which the chromosomes are copied is called **DNA replication**, a chemical reaction in which the two strands of a **parent DNA molecule** are separated, and free DNA nucleotides are used to construct complementary strands, forming two **daughter DNA molecules**, as in **Figure 1.06**. First, the two polynucleotide strands in the parent DNA molecule are separated, allowing each parent strand to serve as a template for synthesising one new strand. In living things, this separation is facilitated by the enzyme helicase, which breaks the weak hydrogen bonds between the base pairs in the parent strands. Next, the enzyme DNA polymerase binds free DNA nucleotides and attaches them to their complementary base pair on the exposed parent strands. Finally, DNA polymerase connects the nucleotides, forming the sugar-phosphate backbones of the daughter molecules.

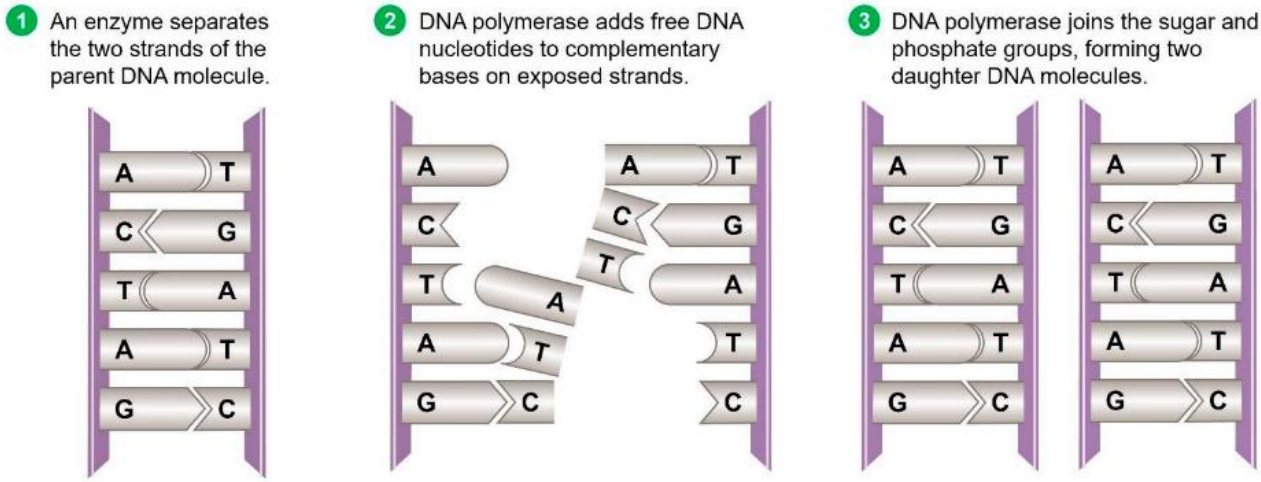


Figure 1.06: DNA replication process.

During DNA replication, the two strands of the parent molecule separate, and each functions as a template for synthesising a complementary strand. In this way, DNA replication is a **semi-conservative process** as when a double helix replicates, each of the daughter molecules has one old strand from the parent molecule and one new strand from DNA replication, as in **Figure 1.07**.

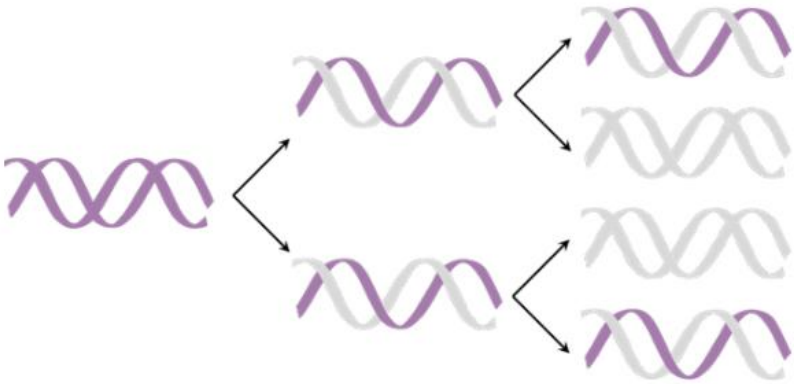


Figure 1.07: The semi-conservative model of DNA replication

DNA Replication and Inheritance

DNA replication allows genetic information to be inherited from a parent cell to daughter cells, ensuring each has a complete set of chromosomes containing the genetic information that programs a cell's activities that help it survive and reproduce. In eukaryotes, the process of inheritance begins with DNA replication. Before replication, the cell has two or more linear bodies called **unduplicated** or **unreplicated chromosomes.** During replication, each chromosome is replicated, and the two daughter DNA molecules are connected, forming X-shaped bodies called **duplicated** or **replicated chromosomes**. The two daughter DNA molecules are separated during cell division, and each is partitioned into a daughter cell, as in **Figure 1.08**. DNA replication occurs in the **synthesis 'S' phase** of the cell cycle in eukaryotes, and its length varies between species. In humans, S phase lasts 8 hours and replicates 46 chromosomes.

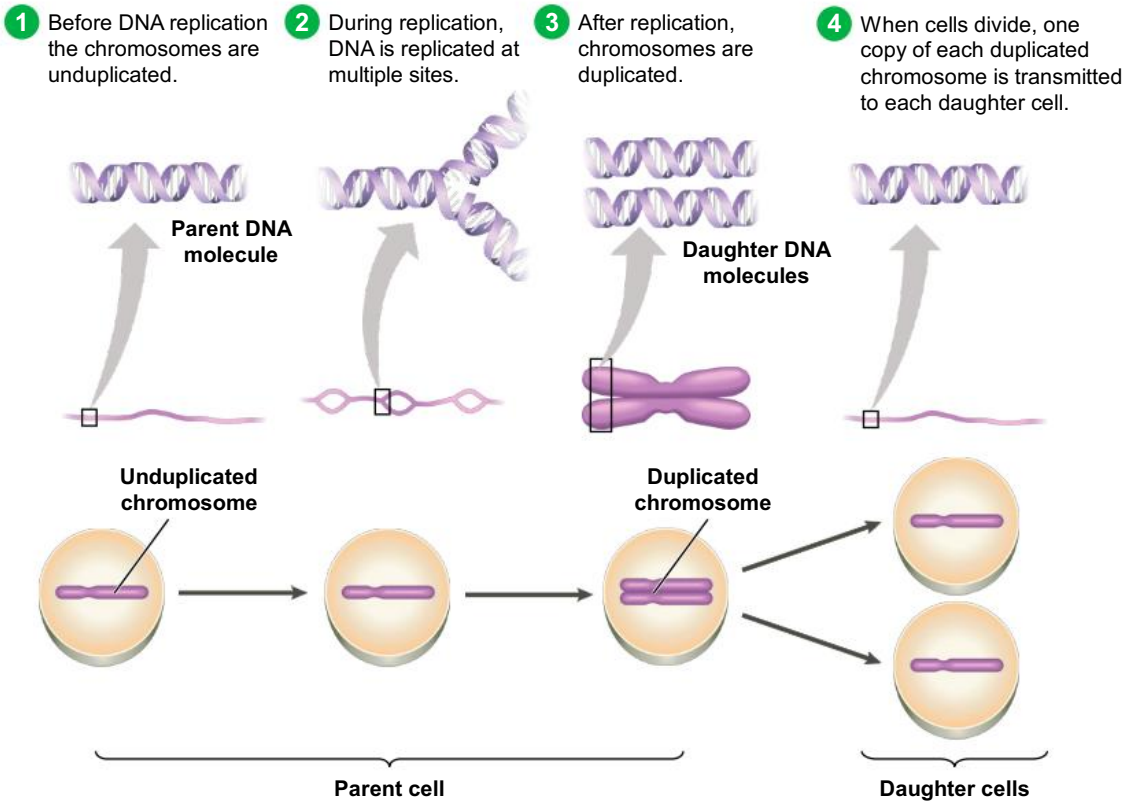
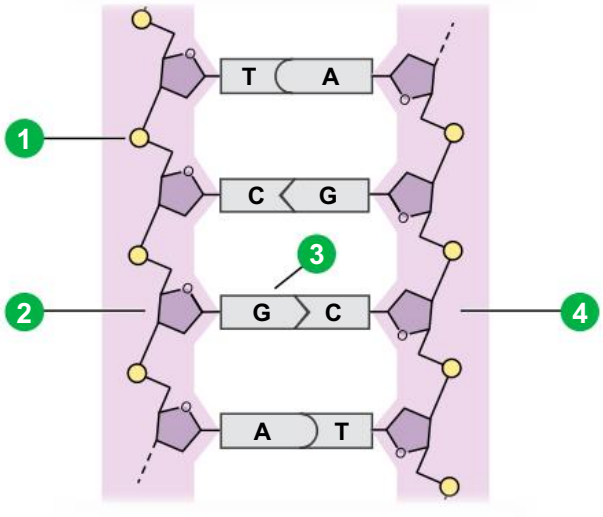


Figure 1.08: DNA replication and the transmission of genetic material.

In prokaryotes, DNA replication is more rapid as the single circular chromosome is much shorter in length than most eukaryotic chromosomes. In favourable environments, some bacteria can replicate their DNA in less than 15 minutes. Biologists have studied the processes of DNA replication extensively in prokaryotes and eukaryotes and concluded that most of the process is fundamentally similar, indicating that DNA replication methods are universal.

Question 1

The diagram below shows a short section of DNA.



(a) Name the components **1**–**4**.

(4 marks)

(b) Describe the structure of a DNA molecule.

(3 marks)

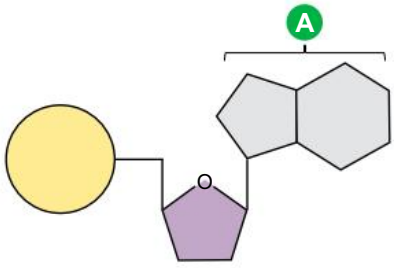
Question 2

DNA is a macromolecule in the cells of all living things.

(a) State the name of this type of macromolecule.

(1 mark)

(b) DNA molecules are composed of nucleotides, like the one shown below.



(1) Name the component of the nucleotide labelled A in the diagram.

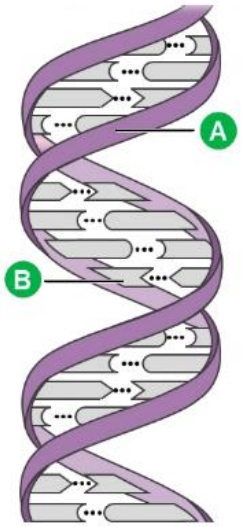
(1 mark)

(2) Describe how the structural units in the diagram are arranged in DNA molecules.

(3 marks)

Question 3

The diagram opposite shows the DNA double helix.



The double helix may be described as a coiled ladder.

(a) State the composition of the uprights of the ladder, labelled **A**.

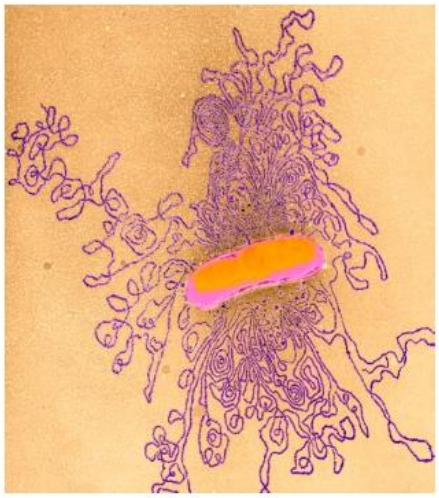
(1 mark)

(b) The rungs of the ladder are made by pairing components labelled **B**.
Name the components and their specific pairs.

(2 marks)

Question 4

The diagram opposite is a coloured transmission electron micrograph (TEM) of the bacterium *Escherichia coli*.



The cell has burst, and the chromosome has leaked out.

(a) Describe the structure and composition of the bacterial chromosome.

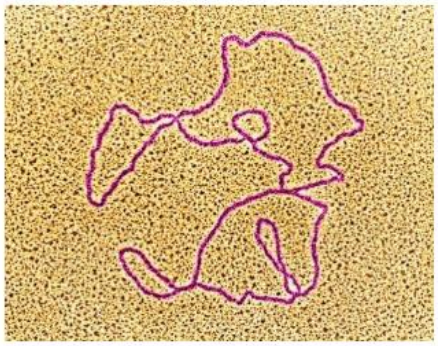
(2 marks)

(b) State the location of the chromosome before it leaked out of the cell.

(1 mark)

Question 5

The diagram opposite is a coloured TEM of mitochondrial DNA.



(a) Describe the structure of mitochondrial DNA using evidence from the diagram.

(2 marks)

(b) Mitochondrial DNA has a similar structure to DNA in prokaryotes.
Give one reason for this.

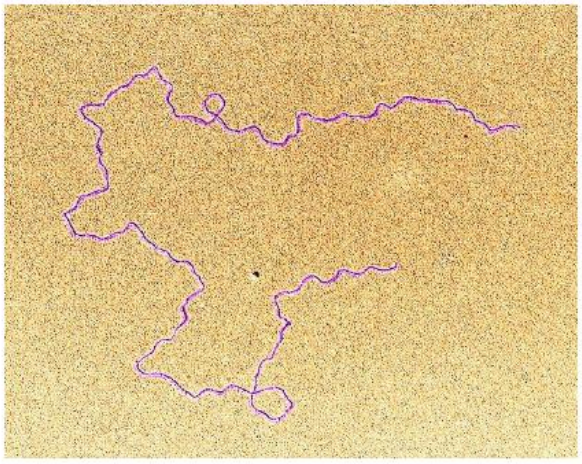
(1 mark)

(c) Mitochondria are one type of organelle containing DNA.
Name two other organelles that contain DNA.

(2 marks)

Question 6

The diagram below is a coloured TEM of a DNA molecule from the nucleus of a eukaryotic cell.



(a) State the evidence from the diagram showing this DNA molecule is from a eukaryotic cell.

(1 mark)

(b) The DNA molecule shown is one of twelve chromosomes in this cell.
Describe the structure of the twelve chromosomes in this eukaryotic cell.

(3 marks)

(c) The DNA molecule in the diagram is from the nucleus of a mesophyll cell in *Vicia faba*, the broad bean plant.
Mesophyll cells contain up to 60 chloroplasts, each containing DNA.
State two differences between the DNA in the nucleus and chloroplasts in *Vicia faba*.

(2 marks)

Question 7

The table below shows the relative percentages of the bases in DNA from various species.

Source cell	Percentage of each nucleotide			
	Adenine	Guanine	Thymine	Cytosine
Wheat	27.3	22.7	27.1	22.8
Sea urchin	32.8	17.7	32.1	17.3
Human	30.9	19.9	29.4	19.8

(a) DNA is a double-stranded molecule.
Explain how the data in the table supports the concept of complementary base-pairing.

(2 marks)

(b) Sea urchins and humans are very different species with similar percentages of each base in their DNA.

Use your knowledge of DNA structure and function to explain how this is possible.

(2 marks)

Question 8

A section of a DNA molecule has 74 base pairs.

The two strands of the DNA, one and two, were analysed to find the number of each nucleotide base.

Some of the results are shown in the table.

	Number of nucleotides			
Strand	Adenine	Guanine	Thymine	Cytosine
One				26
Two	9			19

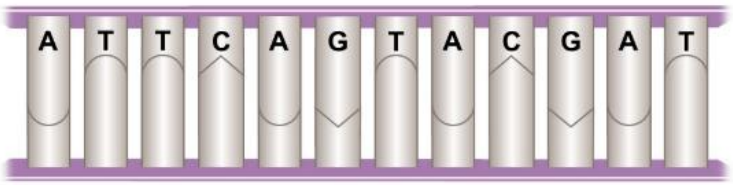
Complete the table by writing in the missing values. (2 marks)

Question 9

The table below shows the bases guanine and cytosine as percentages of the total nucleotides present in three different pathogens.

	Nucleotide composition (%)	
Pathogen	Guanine	Cytosine
Bacterium	36.0	35.7
Fungus	18.7	17.1
Virus	42.0	13.9

(a) The diagram shows a section of DNA from the bacterium.



Write the letters corresponding to the complementary bases on the other strand.

(1 mark)

(b) The viral DNA is different to that of other pathogens in the table.

Use the information in the table to identify and explain the difference.

(2 marks)

(c) The host cell makes a complementary strand to the viral DNA when the virus infects a host.

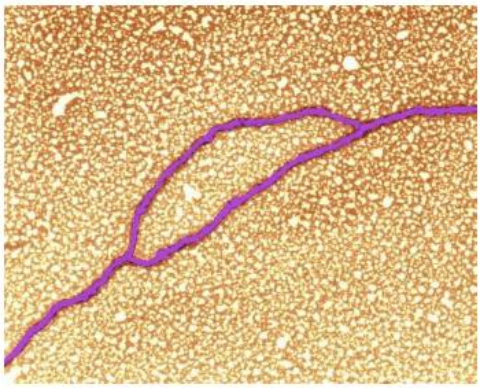
The complementary strand is made the same way as a new complementary strand during semi-conservative replication in human cells.

Describe how the complementary strand of viral DNA is made.

(2 marks)

Question 10

The diagram below is a coloured TEM showing the first stages of DNA replication.



(a) Describe the events occurring in the diagram.

(2 marks)

(b) Explain why DNA replication is described as a semi-conservative process.

(2 marks)

Question 11

Living things duplicate their DNA through semi-conservative replication.

(a) Give two features of DNA and state how each is essential to semi-conservative replication.

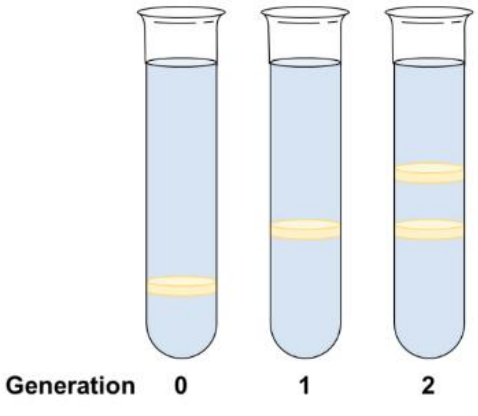
(2 marks)

(b) In 1958, Matthew Meselson and Franklin Stahl carried out an experiment that provided evidence to support the hypothesis of semi-conservative replication of DNA.

Meselson and Stahl grew *E. coli* bacteria in a growth medium that contained only the more massive isotope of nitrogen ^{15}N.

They transferred the bacteria to a growth medium with less massive nitrogen isotope ^{14}N and allowed the bacteria to undergo cell division.

After each division, the DNA from some of the bacteria was extracted from the culture and centrifuged to separate DNA molecules by mass.



The diagram shows the DNA bands in the centrifuge tubes after several divisions.

The tube labelled Generation 0 shows a single band of DNA with bases containing only the more massive nitrogen isotope ^{15}N.

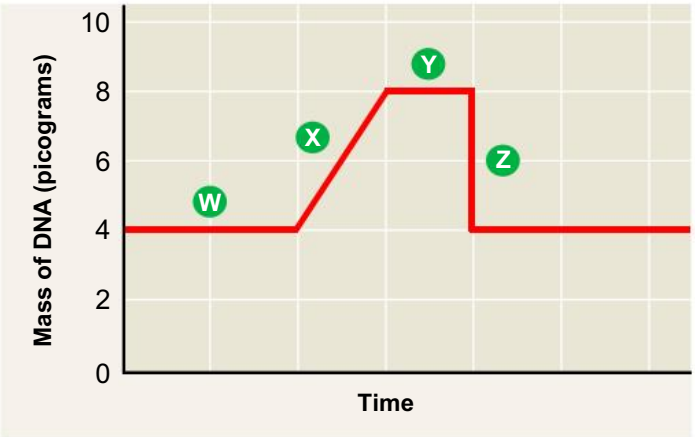
Explain how the results from the other generations provide evidence to support the hypothesis that DNA replication is semi-conservative.

(3 marks)

Question 12

Cancer is a disease characterised by abnormal cell division and tissue growth.

The graph below shows changes in the mass of DNA in a cancer cell over 24 hours.



(a) State the letter of the graph corresponding to:

(1) DNA replication.

(1 mark)

(2) Cell division.

(1 mark)

(b) Cancer is treated with chemotherapy, using drugs that inhibit cell division.

Some chemotherapy drugs inhibit DNA replication.

Suggest how each of the following drugs inhibits DNA replication.

(3) Methotrexate inhibits several enzymes responsible for nucleotide synthesis.

(1 mark)

(4) Chlormethine cross-links the two strands of the parent molecule.

(1 mark)

(5) Cladribine inhibits DNA polymerase.

(1 mark)

Ribonucleic acid (RNA)

We have established that living things contain DNA arranged into one or more chromosomes, each carrying genetic information that programs a cell's activities. The DNA, however, is not directly involved in running the operations of the cell. Instead, DNA directs the synthesis of macromolecules, specifically **ribonucleic acid (RNA)** and proteins that carry out the cell's biological functions. This section describes how DNA directs RNA synthesis and, through RNA, controls protein synthesis.

RNA is a nucleic acid, a macromolecule with a similar structure to DNA. Like DNA, RNA is composed of repeating nucleotides, each composed of a sugar, phosphate and one of four nitrogenous bases, including adenine, guanine and cytosine. Like DNA, the sugar and phosphate groups of the nucleotides in RNA are joined, forming the sugar-phosphate backbone. However, unlike DNA, RNA molecules are **single-stranded** rather than double-stranded and do not form a double helix. In addition, RNA nucleotides contain **ribose** rather than deoxyribose as their sugar, and the fourth base in RNA is **uracil (U)** rather than thymine (T) (**Figure 1.09**). Finally, unlike DNA, a cell has many different types of RNAs, including **messenger RNA (mRNA)**, **transfer RNA (tRNA)** and **ribosomal RNA (rRNA)**, each with a unique structure and function. These RNA molecules vary in size but are generally smaller than DNA molecules.

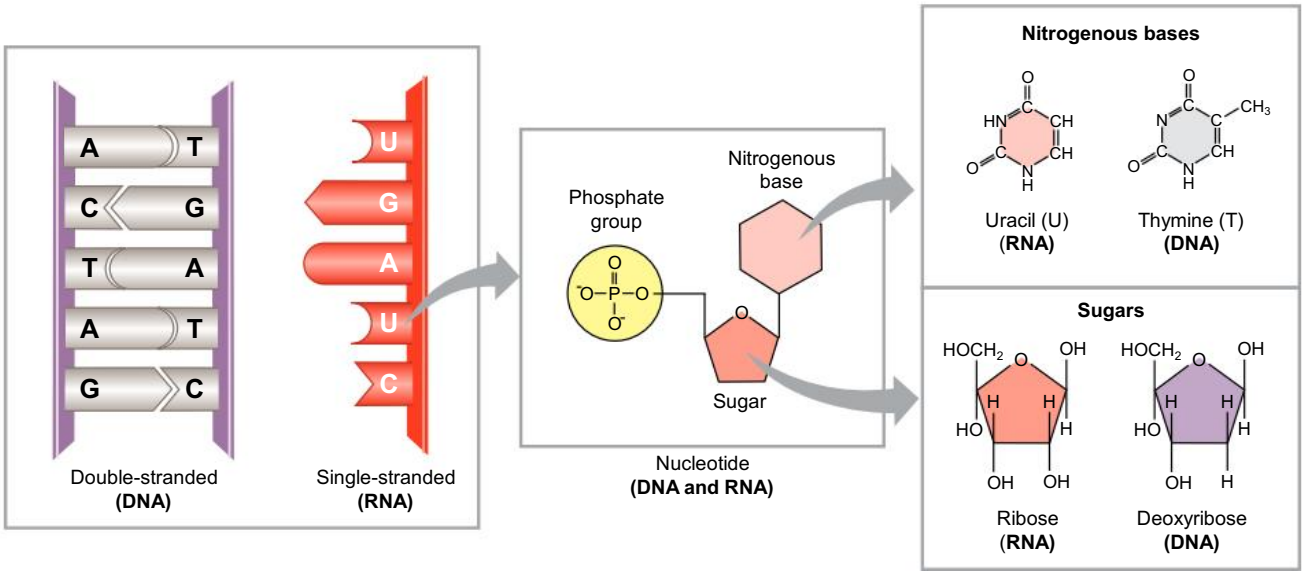


Figure 1.09: Structural differences between DNA and RNA.

Genes

The DNA molecules in cells are arranged into one or more chromosomes, each containing hundreds to thousands of **genes**, nucleotide sequences that code for proteins and the RNA molecules that carry out protein synthesis. Proteins are macromolecules composed of long chains of amino acids folded into unique shapes that give cells their structure and functions. Genes are typically hundreds to thousands of nucleotides long, each having a unique nucleotide base sequence coding for the synthesis of part or all of a protein or RNA molecule. Genes are genetic information coding for inherited traits such as antibiotic resistance in bacteria, drought resistance in plants, and animal blood type. The DNA inherited by a living thing called its **genotype**, leads to specific physical and behavioural traits, called **phenotypes**, by dictating protein synthesis. For example, in the case of antibiotic resistance in bacteria, the resistance gene contains the information to synthesise an enzyme (protein) that breaks down antibiotics, protecting the cell from damage. The process by which DNA directs RNA and protein synthesis is called **gene expression** and includes two stages: **transcription** and **translation** (**Figure 1.10**). In transcription, the DNA nucleotide sequence of a gene is rewritten into a complementary RNA nucleotide sequence. The resulting RNA molecule is a reliable transcript of the gene's protein-synthesising instructions. The RNA molecule synthesised from a protein-coding gene is called messenger RNA (mRNA), as it carries the genetic message from

genes to the cell's protein-synthesising machinery. In translation, the nucleotide sequence on the mRNA molecule is translated into an amino acid sequence, forming a polypeptide that is folded into a functional protein. The sites of translation are **ribosomes**, macromolecular complexes that link the amino acids to form a polypeptide that folds into a functional protein.

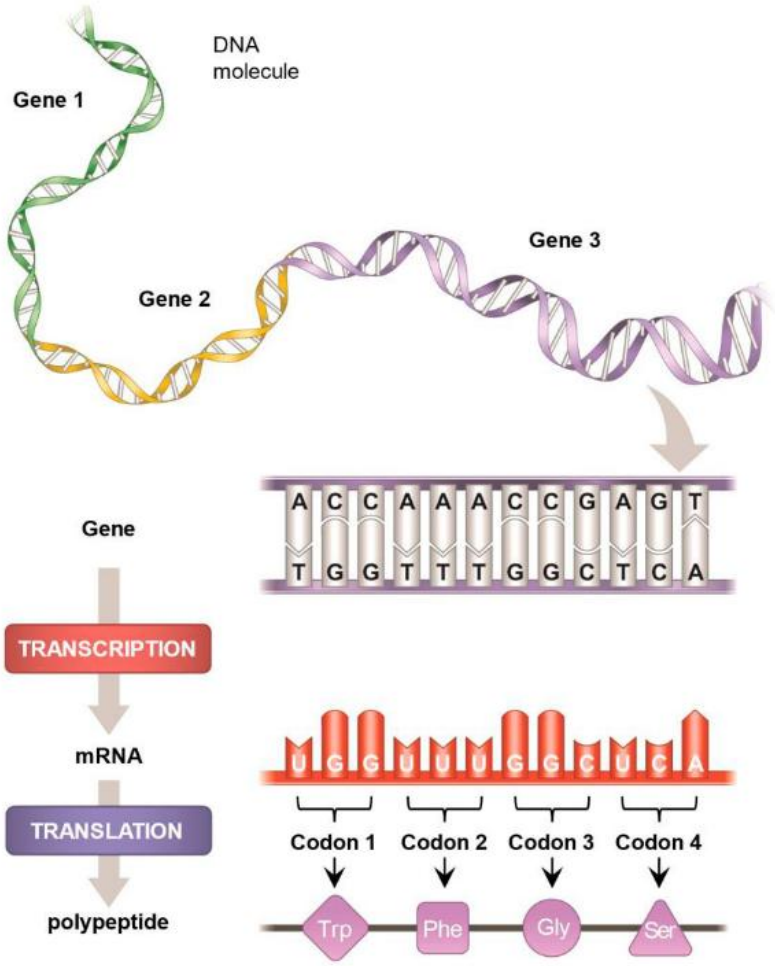


Figure 1.10: Gene expression.

Transcription and translation occur in all living things, with the basic mechanics being similar for prokaryotes and eukaryotes. Still, there is an essential difference in the flow of genetic information between the two cell types. Prokaryotes lack nuclei, so nuclear membranes do not separate the DNA and mRNA from ribosomes and the other protein-synthesising machinery, as in **Figure 1.11**. This lack of compartmentalisation in prokaryotic cells allows translation to begin while transcription occurs, resulting in rapid protein synthesis. In contrast, eukaryotic cells have a nucleus with a membrane separating transcription from translation, as shown in **Figure 1.11**. Transcription occurs in the nucleus, but the mRNA must be transported to the cytoplasm for translation, preventing translation from starting until transcription has been completed. Furthermore, the transcription of a protein-coding gene in eukaryotes produces pre-mRNA, an RNA molecule with a complementary nucleotide sequence to its gene. In most cases, the pre-mRNA molecule is modified by enzymes in the nucleus to produce a mature mRNA molecule ready for translation. While processing RNA, both ends of the pre-mRNA molecule are modified, specific interior sections are cut out, and the remaining parts are spliced together. The mature mRNA molecule then leaves the nucleus and enters the cytoplasm, which is translated into a polypeptide by ribosomes.

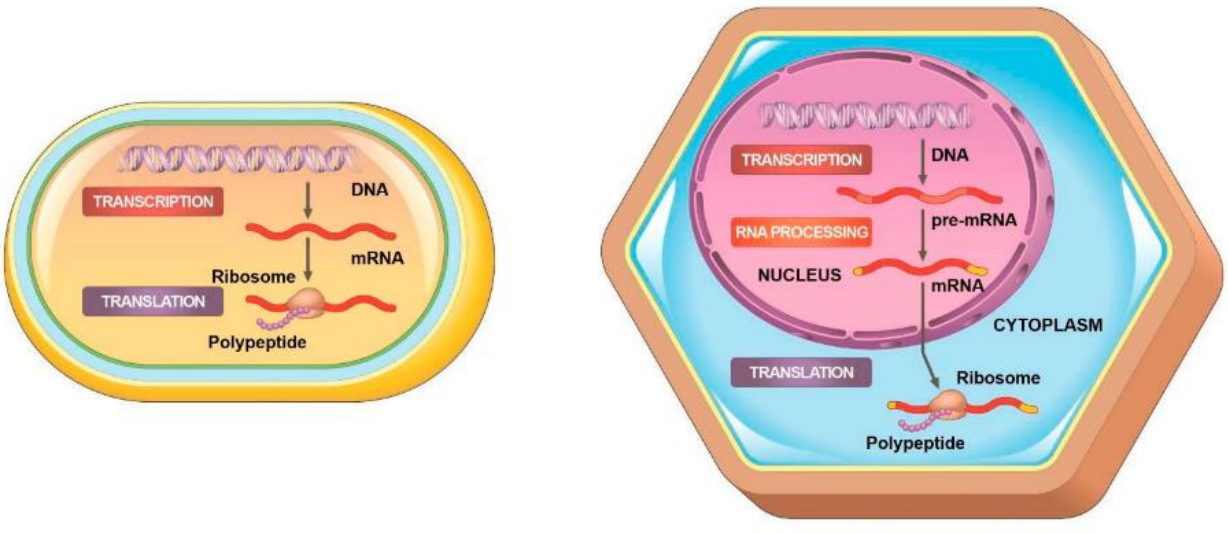


Figure 1.11: Gene expression in prokaryotic cels (left) and eukaryotic cells (right).

RNA Processing

In eukaryotes, the transcription of genes produces **pre-mRNA**, a molecule with the same length as its gene and a nucleotide sequence complementary to its gene. Following transcription, enzymes in the eukaryotic nucleus modify pre-mRNA into a **mature mRNA** molecule ready for translation. Firstly, the ends of the pre-mRNA are modified by adding chemical groups that facilitate the export of the mature mRNA molecule from the nucleus to the cytoplasm while preventing degradation by enzymes and helping the molecule attach to ribosomes. Secondly, one or more portions of the pre-mRNA molecule are removed, and the remaining portions are reconnected, a process called **RNA splicing**. For example, a gene and the pre-mRNA molecule transcribed from it may be 28,000 nucleotides long. However, the mature mRNA molecule translated by ribosomes may only be 1,400 nucleotides long. This is because most eukaryotic genes and their RNA transcripts have long stretches of non-coding nucleotides that are not translated, many of which are interspersed between coding segments of the gene and pre-mRNA. The non-coding segments of the gene and pre-mRNA between coding regions are intervening sequences called **introns**. The coding segments are eventually expressed into a polypeptide and are called **exons**. In RNA splicing, the introns are cut out from the molecule, and the exons are joined together, forming an mRNA molecule with a continuous coding sequence (**Figure 1.12**).

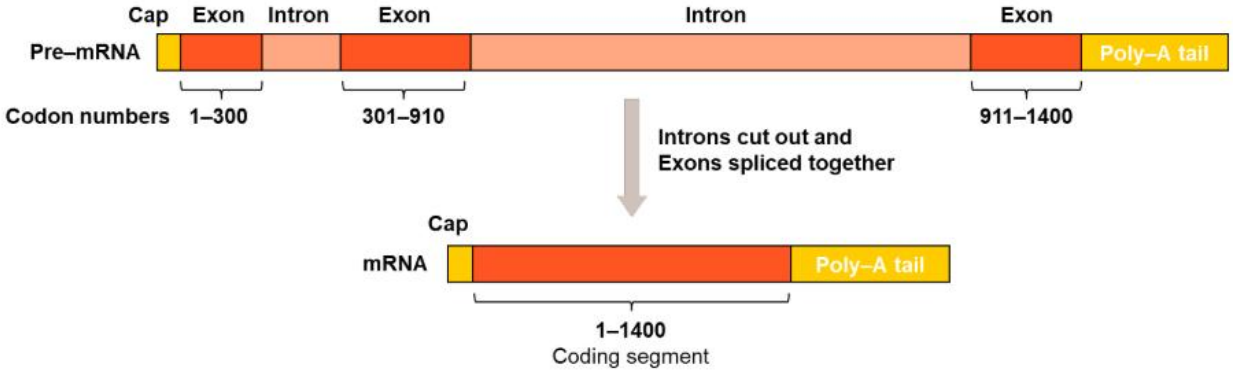


Figure 1.12: RNA processing

The removal of introns is accomplished by a **spliceosome**, a large complex made of protein and small RNA molecules. A spliceosome binds to several short nucleotide sequences along an intron, including critical sequences at each end and cleaves these regions to release the intron (**Figure 1.13**). The intron is rapidly degraded, and the spliceosome joins the two exons on either side of the intron.

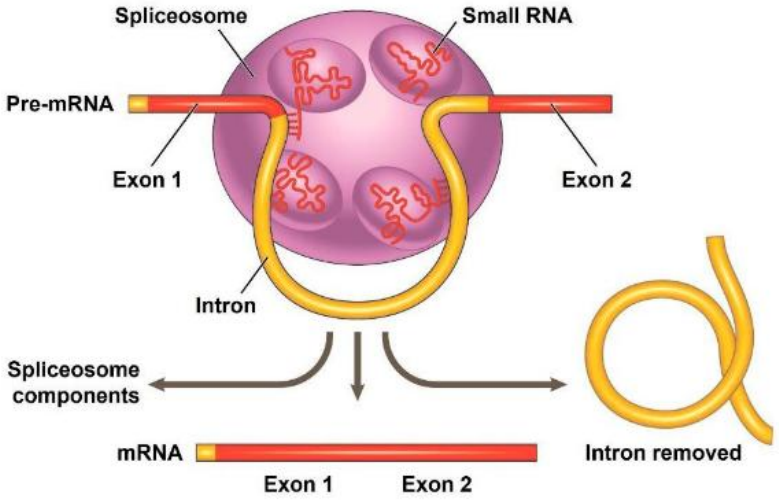


Figure 1.13: RNA splicing

One crucial consequence of introns in eukaryotes is that a single gene can encode more than one polypeptide depending on which segments are treated as exons during RNA processing. In some cases, a single gene containing many exons can be spliced together in different ways, called **alternative RNA splicing**, to form a variety of polypeptides with different functions. In other cases, the different exons in a gene code for a different section or **domain** of the protein. Because of alternative splicing, the number of different protein products a living thing produces can be much greater than its number of genes. This is one reason humans carry out more complex functions than other species with the same number of genes.

Question 13

Coronaviruses have RNA as their genetic material.

(a) Describe the structure of RNA.

(3 marks)

(b) Coronaviruses infect human cells.

Give three differences between the genetic material in coronaviruses and human cells.

(3 marks)

Question 14

The table below shows the base sequence of part of a pre-mRNA molecule from a eukaryotic cell.

DNA	
Pre-mRNA	ACGCAUUAU

(a) Complete the table with the DNA base sequence from which this pre-mRNA was transcribed. (2 marks)

(b) Explain why the pre-mRNA nucleotide sequence may differ from the mature mRNA.

(2 marks)

Question 15

The table shows the percentage of different bases in two pre-mRNA molecules.

The molecules were transcribed from the DNA in different parts of a chromosome.

Part of chromosome	Percentage of each nucleotide			
	Adenine	Guanine	Cytosine	Uracil
Middle	38	20	24	
End	31	22	26	

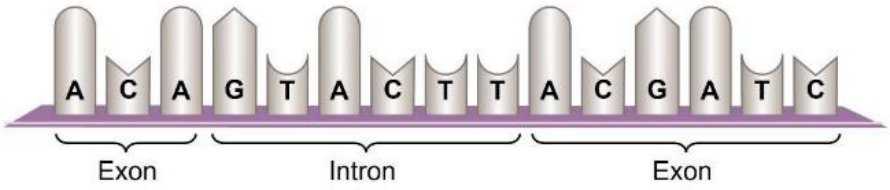
(a) Complete the table by writing the percentage of uracil in the appropriate boxes. (2 marks)

(b) Explain why the percentages of bases from the middle part of the chromosome differ from those at the end of the chromosome.

(2 marks)

Question 16

The diagram shows the bases on one strand of a DNA molecule.



(a) Give the nucleotide sequence of the pre-mRNA molecule transcribed from this strand.

(1 mark)

(b) Give the nucleotide sequence on the mature mRNA produced from the pre-mRNA.

(1 mark)

(c) Describe the process that converts pre-mRNA to a mature mRNA.

(2 marks)

Question 17

The fruit fly (*Drosophila melanogaster*) contains a gene called Dscam encoding a protein receptor.

(a) Define a gene using the example of Dscam.

(1 mark)

(b) Dscam contains 95 exons and more than 100 introns.

(1) State the difference between exon and intron sequences in Dscam.

(1 mark)

(2) Explain how the expression of Dscam can produce 38,016 different mature mRNAs.

(2 marks)

UNIT 3:
How do cells maintain life?

AREA OF STUDY 1: What is the role of nucleic acids and proteins in maintaining life?

3.2 DNA Manipulation Techniques and Applications