

REVISION: DNA, RNA & MEIOSIS

13 MARCH 2013

Lesson Description

In this lesson we revise”

- The structure and functions of DNA
- The structure of RNA and its role in protein synthesis
- The process of cell division

Key Concepts

Where do we find DNA?

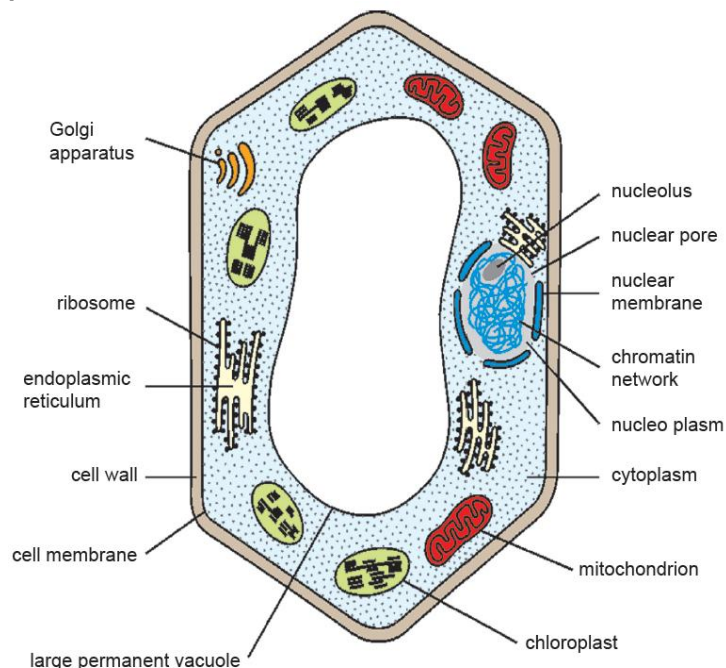
(Life Sciences for All, Chapter 4 DNA and the genetic code)

There are two kinds of nucleic acids:

deoxyribonucleic acid (**DNA**), ribonucleic acid (**RNA**).

DNA is found in the nucleus of **eukaryotic cells** where it forms part of the **chromatin**. Some also found inside the **mitochondria** and **chloroplasts** of these cells.

Figure 4.1 A typical Plant Cell



(Life Sciences for All, Chapter 4 DNA and the genetic code, pg 183)

The Structure of DNA

(Life Sciences for All, Chapter 4 DNA and the genetic code)

DNA is a polynucleotide. A polynucleotide is a very large molecule made up of a string of repeating units called **nucleotides**.

Each DNA nucleotide consists of three parts:

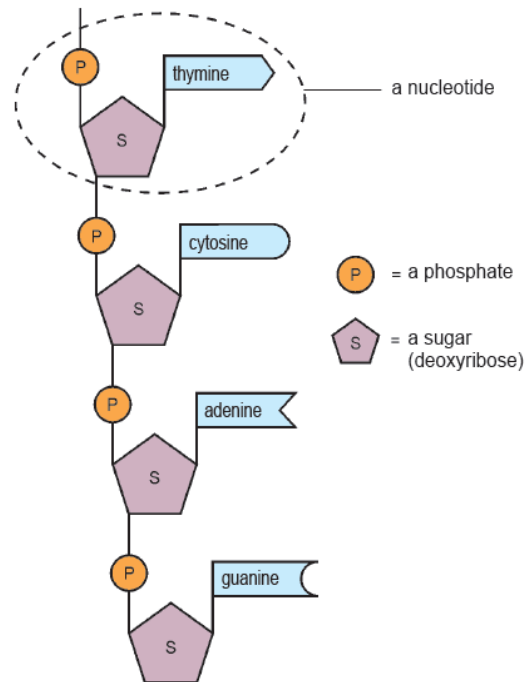
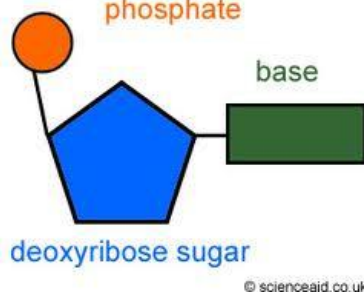
- one **deoxyribose** sugar molecule

- one **phosphate** group
- one **nitrogen-containing base**.

There are four possible bases that can form part of a nucleotide:

- **adenine (A)**
- **thymine (T)**
- **guanine (G)**
- **cytosine (C)**

Figure 4.2 A Polynucleotide
phosphate



Adenine and guanine are **double-ringed molecules** called **purine bases**. Thymine and cytosine are **single-ringed molecules** called **pyrimidine bases**.

Questions

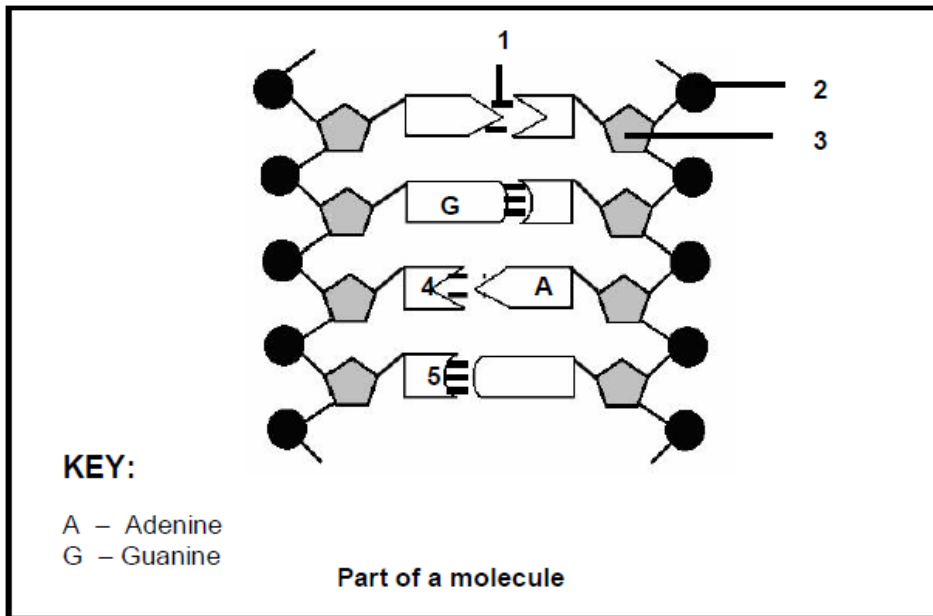
Question 1

Give the correct biological term for the following:

- The base that pairs with thymine
- The building blocks of proteins
- The bonds that hold the two polynucleotide strands of a DNA molecule together
- Repeating units (monomers) that form a nucleic acid
- Sugar that forms part of DNA
- The shape of a DNA molecule.

Question 2

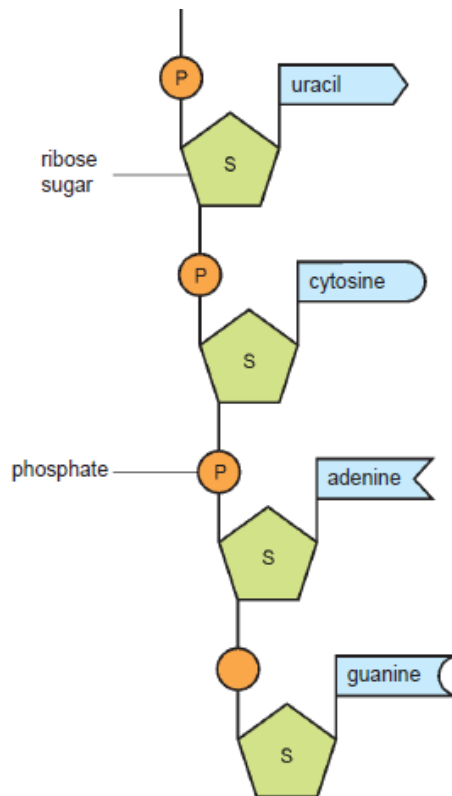
The diagram below represents a part of a molecule. Study the diagram and answer the questions that follow.



- | | | |
|-----|---|-----|
| a.) | Identify the molecule in the above diagram. | (1) |
| b.) | Label the parts numbered 1 and 5 respectively. | (2) |
| c.) | What is the collective name for the parts numbered 2, 3 and 4? | (1) |
| d.) | What is the significance of this molecule being able to replicate itself? | (2) |

The Structure of RNA

- RNA - Single-stranded polynucleotide.
- The nucleotides of RNA differ slightly from those of DNA. An RNA nucleotide consists of:
 - A **ribose** sugar
 - A phosphate
 - One of four bases: Either **uracil**, cytosine, guanine or adenine.



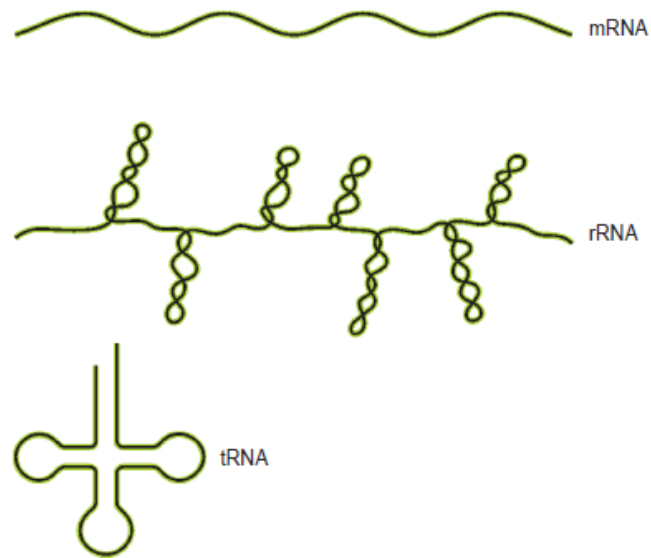
(Structure of RNA from Life Sciences for all, Grade 12, Figure 4.14, Page 193)

Types of RNA

RNA is manufactured by DNA. There are three types of RNA.

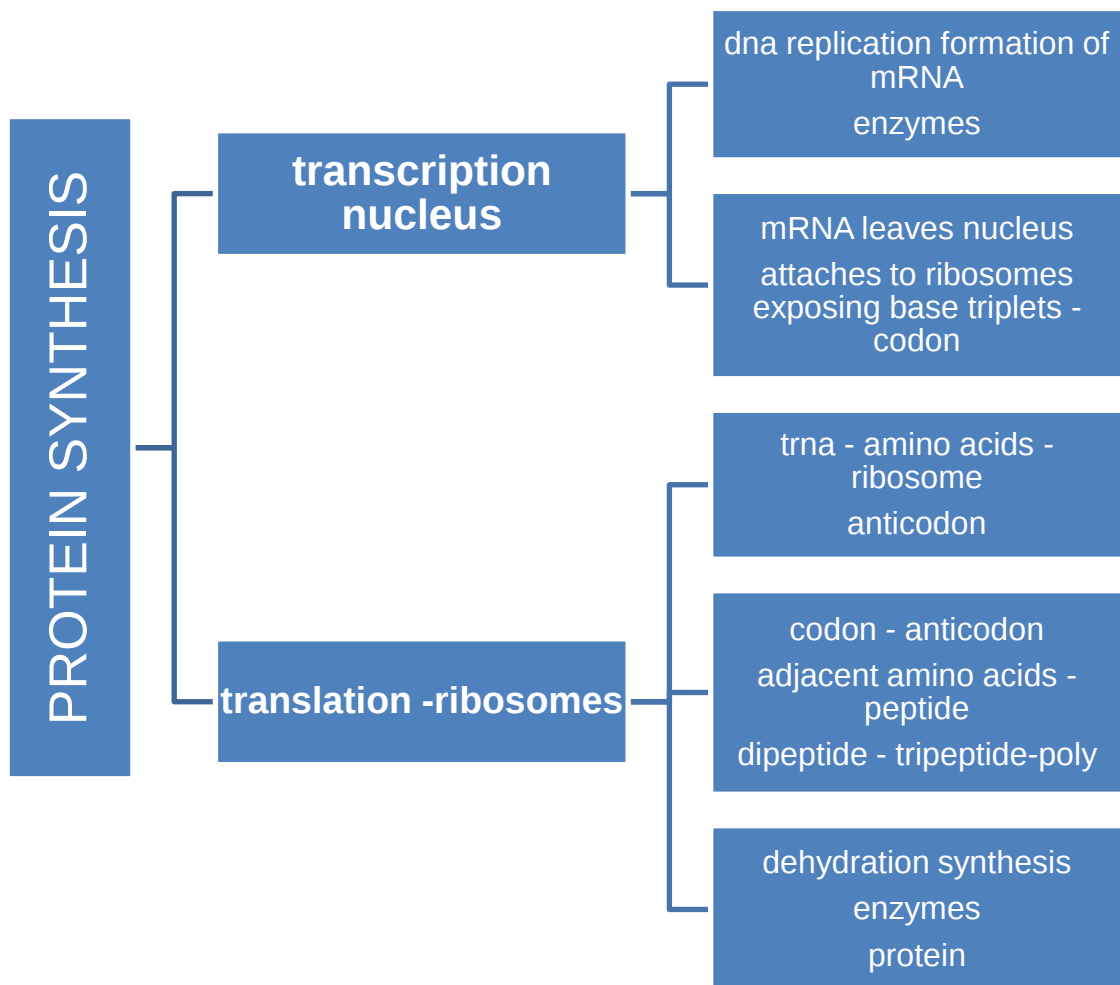
The three types of RNA:

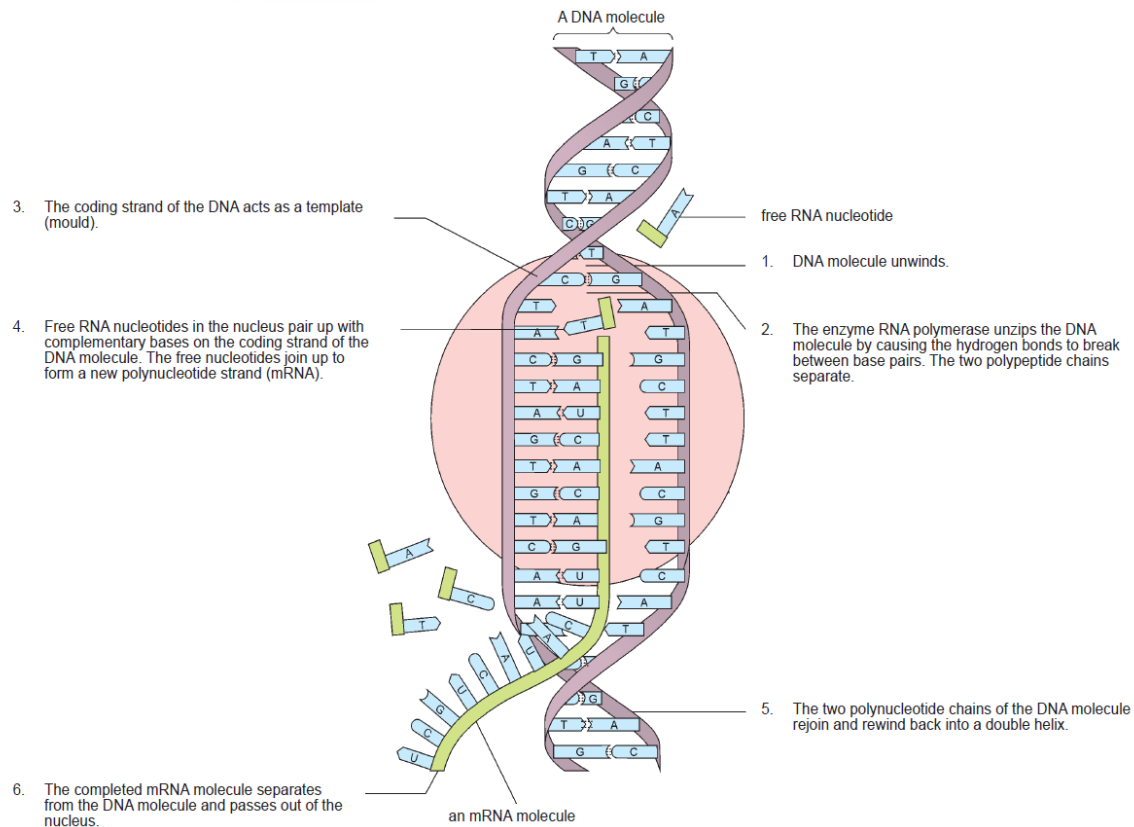
1. Messenger RNA (mRNA). It carries information about the amino acid sequence of a particular protein from the DNA in the nucleus to the ribosome where the protein will be made.
2. Ribosomal RNA (rRNA) has no precise shape. It forms the ribosomes, which are found in the cytoplasm of the cell, that make proteins.
3. Transfer RNA (tRNA) is a small molecule with a cloverleaf shape. It picks up amino acids in the cytoplasm and brings them to the ribosomes where they are joined together to form a protein.



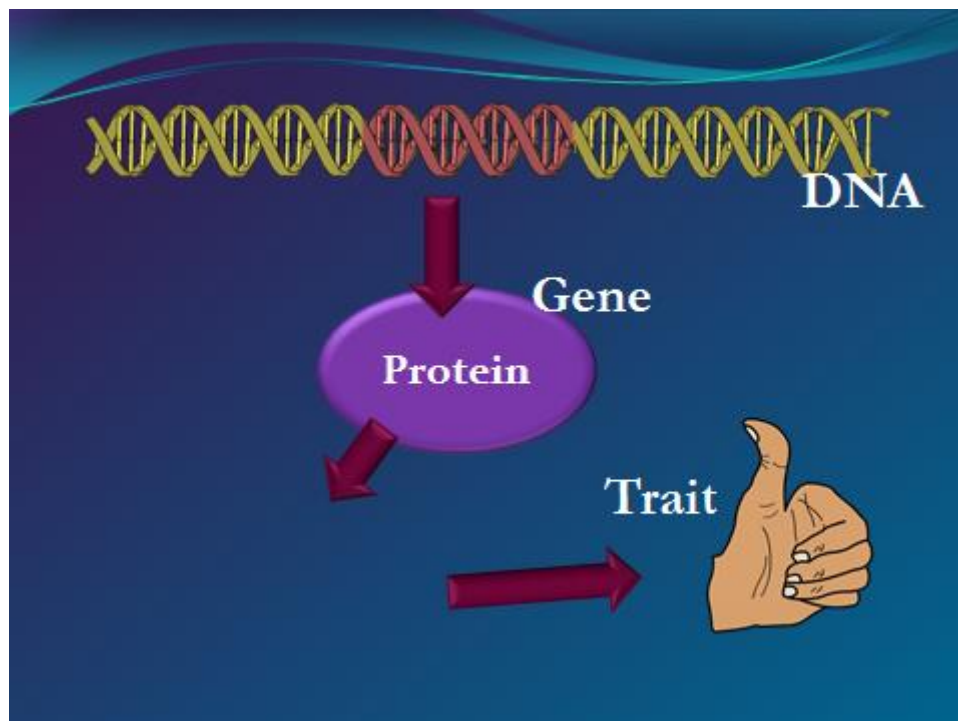
(The Three Types of RNA from Life Sciences for all, Grade 12, Figure 4.15, Page 193)

Protein Synthesis





(Transcription from *Life Sciences for all*, Grade 12, Figure 4.16, Page 194)



Questions

Question 1

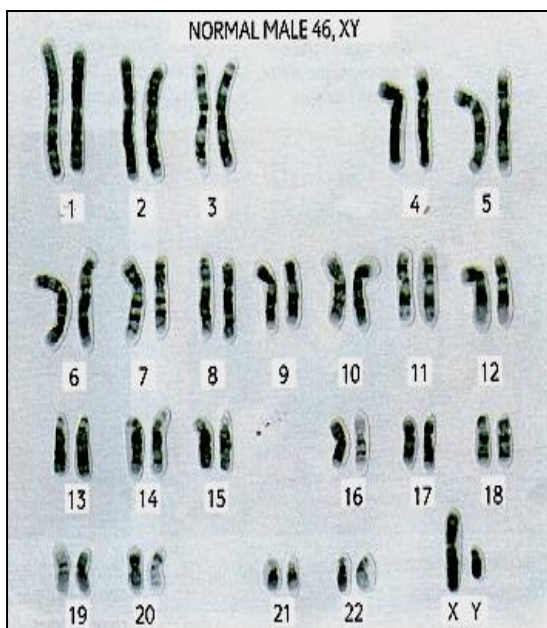
Give the correct biological term for the following:

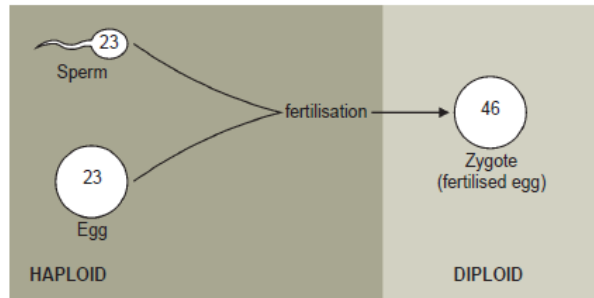
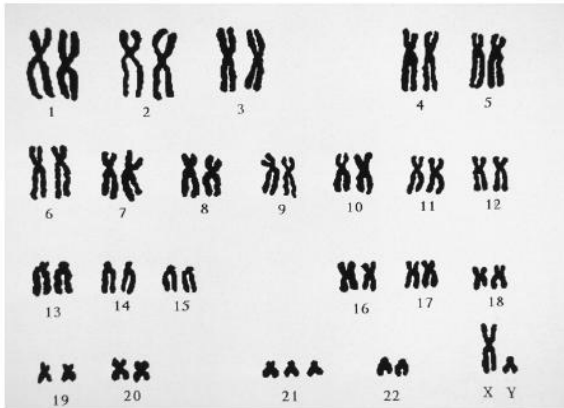
- the nitrogenous base which is found in RNA but not DNA
- a triplet of three bases found on an mRNA
- the single strand of DNA that contains the instructions for making a protein
- the type of RNA that picks up amino acids in the cytoplasm and brings them to the ribosomes
- factors that cause mutations in DNA and chromosomes
- the synthesis of mRNA from DNA.

Key Concepts

Terminology:

- **Cell division** - process by which cells reproduce – mitosis & meiosis
- **Chromosomes** - cell parts that determine what traits a living thing will have
- **Chromatid** - one strand of DNA; after replication, a chromosome is made up of two identical chromatids
- **Daughter cells** - new cells produced by cell division
- **Cytokinesis** – a division of the cytoplasm of one parent cell into 2 daughter cells
- **Karyotype:**
 - Diagram of arrangement of chromosomes
 - Chromosomes are paired according to size
 - Arrangement is called karyogram
 - Set of chromosomes is called a karyotype
 - Human karyogram shows the 23 pairs of chromosomes

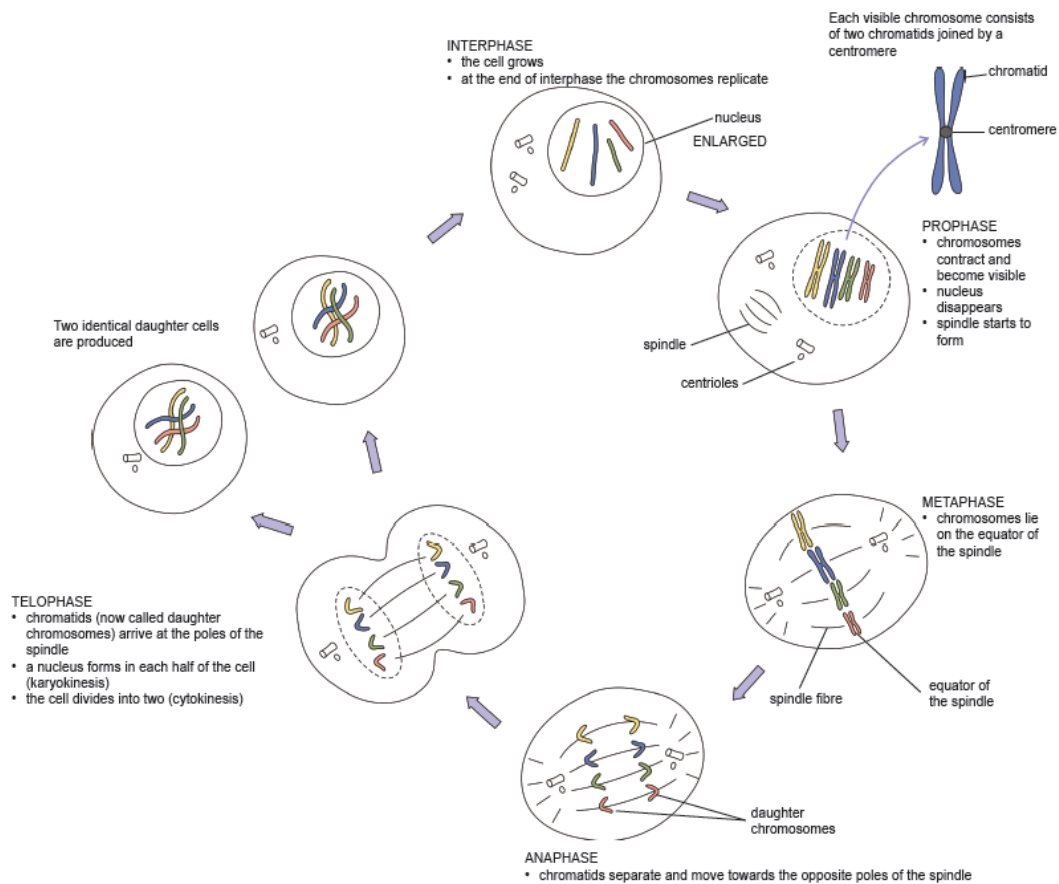




(Figures adapted from *Life Sciences for All, Grade 12, Figure 5.5 and Figure 5.6, Page 228*)

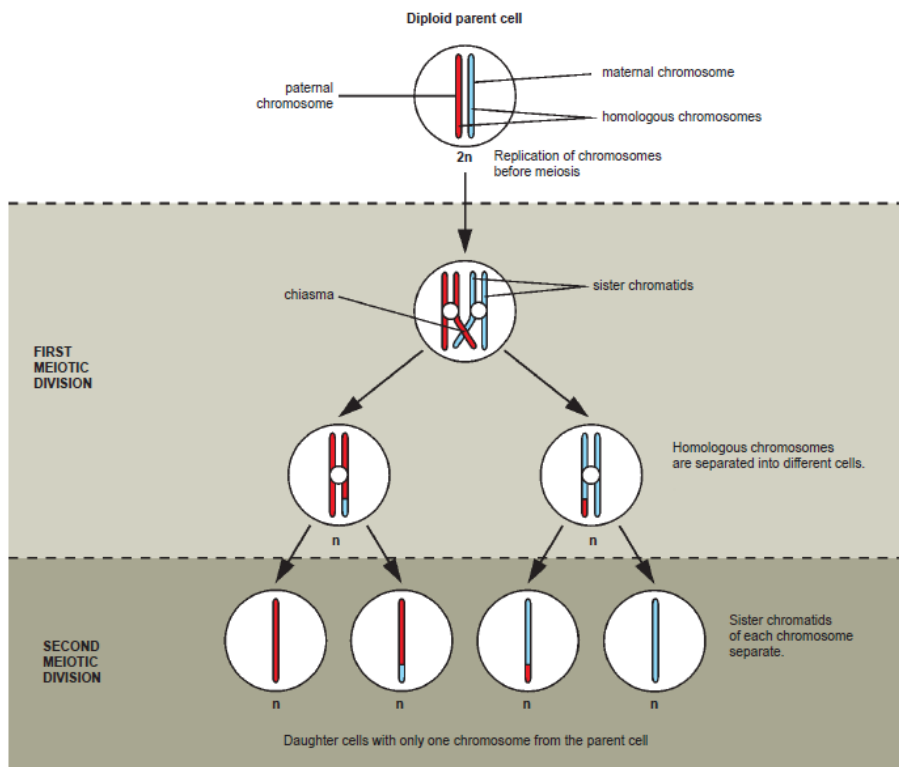
Cell Division:

- The Different Stages of Mitosis:



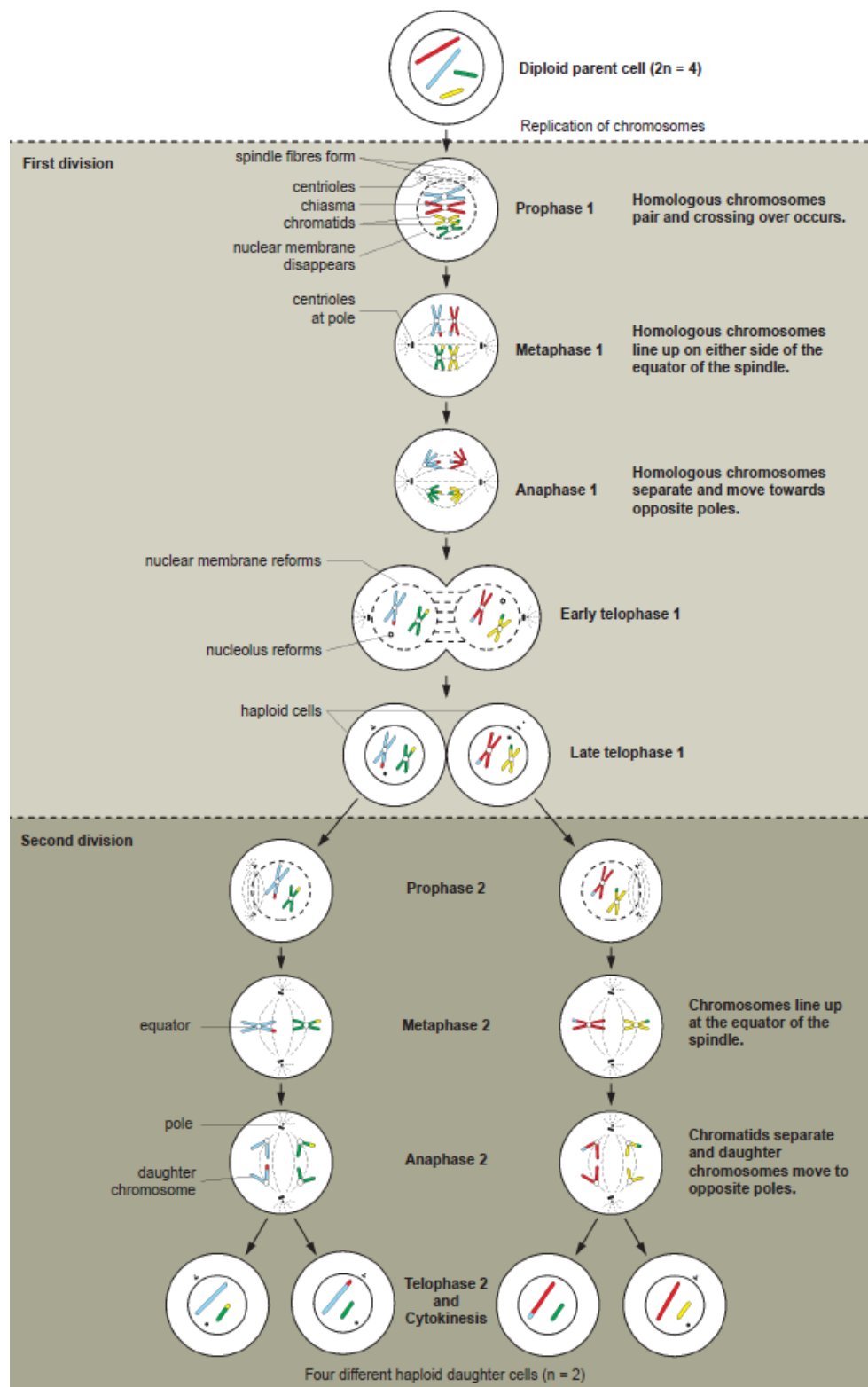
(Figures adapted from *Life Sciences for All, Grade 12, Figure 5.8, Page 233*)

- The Formation of haploid cells by meiosis:



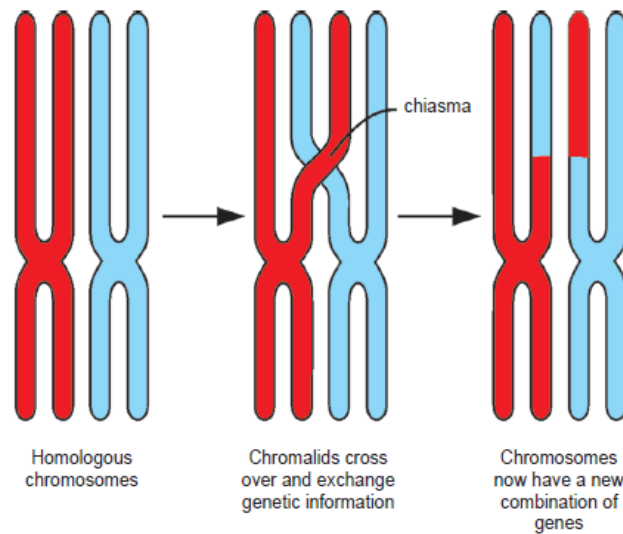
(Figures adapted from *Life Sciences for All, Grade 12, Figure 5.9, Page 234*)

- The behaviour of chromosomes during meiosis:



(Figures adapted from Life Sciences for All, Grade 12, Figure 5.10, Page 236)

- Crossing over during meiosis:



(Figures adapted from *Life Sciences for All, Grade 12, Figure 5.9, Page 235*)

Importance of Meiosis:

- Reduces the number of chromosomes by half
- Formation of gametes - for fertilisation.
- Ensures that the number of chromosomes in the species stays the same over generations
- Meiosis is important to introduce genetic variation.

Questions

Question 1

(*Life Sciences for all, Grade12, Question 1, Page 242*)

Give the correct word or term for the following:

- an organism with more than two complete sets of chromosomes
- the point at which chromatids exchange genetic material during meiosis
- the type of cell division that forms gametes in diploid organisms
- the type of cell division that occurs in somatic cells
- division of the cytoplasm that takes place during division of a cell
- the reproductive organ in human females in which meiosis occurs.