

# BIOLOGY

LEVELS OF LIFE

AUSTRALIAN CURRICULUM EDITION



SAMPLE  
PAGES

WORKBOOK

WITH ANSWERS

BRIAN LECORNU

TONY DIERCKS

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# 1

# Chromosomes and DNA

Subject Outline terms and phrases

**DNA, double-stranded, helical, cytosol, prokaryote, nucleotide, genetic information, eukaryote, chromosome (linear, circular), nucleus**

1. Organisms are made of one or more cells and cells are made of chemicals. Define the following chemical terms:

element:

a chemical substance made up of one kind of atom (*See Textbook Glossary Page 208*)

compound:

a chemical substance made up of two or more different elements chemically combined

molecule:

an uncharged group of atoms chemically combined

organic compound:

a compound that contains carbon. Note that carbon dioxide is not considered to be organic, due to its simplicity.

2. (a) Describe how DNA stores and transmits genetic information.

DNA is a unique molecule because it is able to self-replicate — that is, it can make a copy of itself. In addition, its sequence of nucleotides allows it to store information that can be copied and passed on to daughter cells. Thus DNA, which is found in all known organisms, provides the link between one generation and the next.

- (b) DNA functions in the same way in all living things. Explain what this means.

The genetic code is the same for all living things. This code, which is the sequence of bases on the cell's DNA, uses three bases at a time, called codons, to direct protein synthesis - the assembling of proteins from amino acids. Thus, DNA functions in the same way in all living things.

7. Write the chromosome number on which the gene is located for the following human genetic diseases. (see textbook chapter 1 and 2)

haemophilia X

red-green colourblindness X

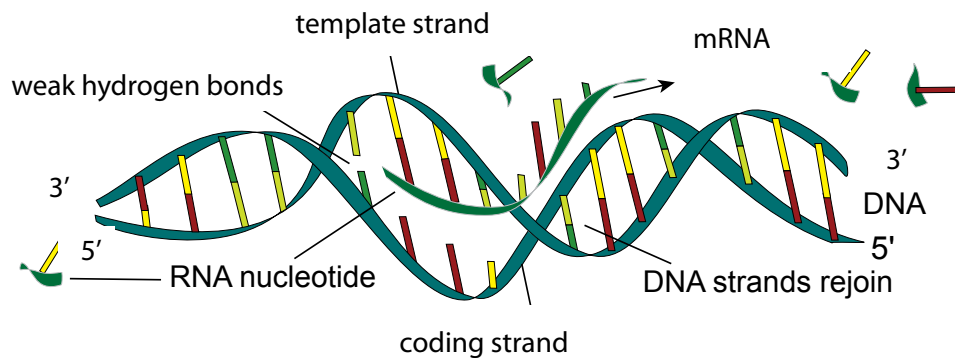
Huntington's disease 4

cystic fibrosis 7

Duchenne muscular dystrophy X

retinitis pigmentosa X

8. (a) On the diagram label the the coding strand, the template strand of DNA, the mRNA, the weak hydrogen bonds, and the ends of the strands



(b) Explain the meaning of 3' to 5' when referring to DNA.

The pentose sugars in nucleotides contain five carbon atoms numbered 1', 2', 3', 4', and 5'. The phosphate group is attached to the 5' carbon of the sugar so where phosphate is at the end of the strand this is the 5' end. Where the strand ends with a nucleotide this is the 3' end. DNA (and RNA) is directional — 3' and 5' are used to indicate the direction. (See text box page 11 of Textbook)

9. Distinguish between DNA codons, RNA codons, and RNA anticodons.

DNA codons:

DNA codons are on the coding strand of DNA, also called the 'gene'.

RNA codons:

RNA codons are on the mRNA.

RNA anticodons:

An anticodon is a triplet of bases on a tRNA molecule that is complementary to the corresponding codon on an mRNA molecule.

# 8

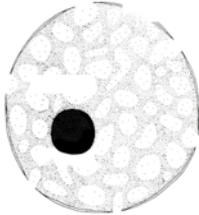

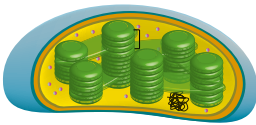



# Cell Structure and Function

Subject Outline terms and phrases

**organelle, nucleus, nucleolus, mitochondrion, chloroplast, vacuole/vesicle, Golgi body, endoplasmic reticulum(rough and smooth), ribosome, lysosome, cytoskeleton**

- For each of the following terms, state whether it refers to the **structure** or **function** of a cell:
 

microscopic	structure	metabolic	function	cell wall	structure
reproduces	function	synthesises protein	function	contains DNA	structure
synthesises DNA	function	spherical	structure	photosynthesises	function
respires	function	cell membrane	structure		
- Complete the table below which shows features of organelles in eukaryotic cells.

Organelle	Diagram	Function	Distinguishing feature(s)
nucleus		controls cell activities	double-membrane nuclear envelope with nuclear pores contains chromatin (DNA and protein) one or more nucleoli
nucleolus (part of the nucleus)		rRNA synthesis	found in nucleus; not surrounded by a membrane
chloroplast		photosynthesis	bounded by two membranes contains pigments such as chlorophyll contains grana and stroma
vacuole/vesicle		maintains water and solute balance stores waste products contributes to growth	bounded by a single membrane filled with fluid may contain pigments
mitochondrion		site of latter stages of aerobic respiration	inner membrane folded to form cristae
Golgi body		packaging and secretion of cell products	stacks of flattened sacs made of smooth membrane

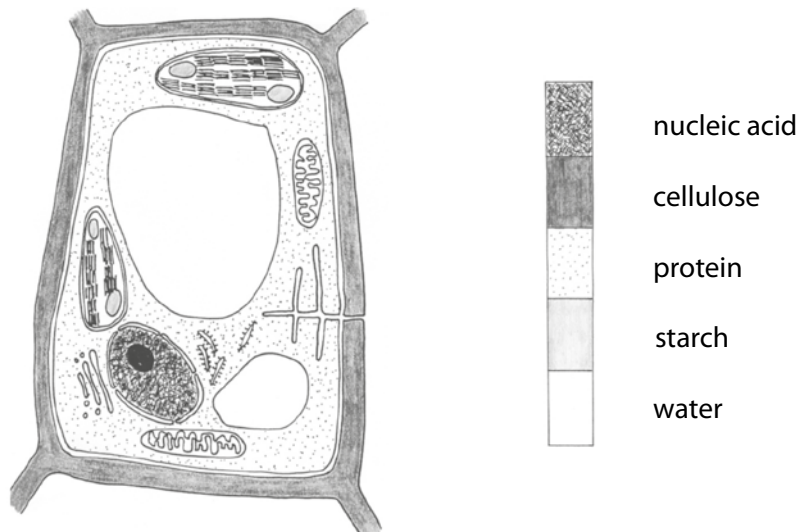
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2. The membrane of a human muscle cell maintains different concentrations of materials inside and outside the cell. Give an example of a substance that has a higher concentration inside a human muscle cell than outside, and an example of a substance that has a higher concentration outside a human muscle cell than inside.

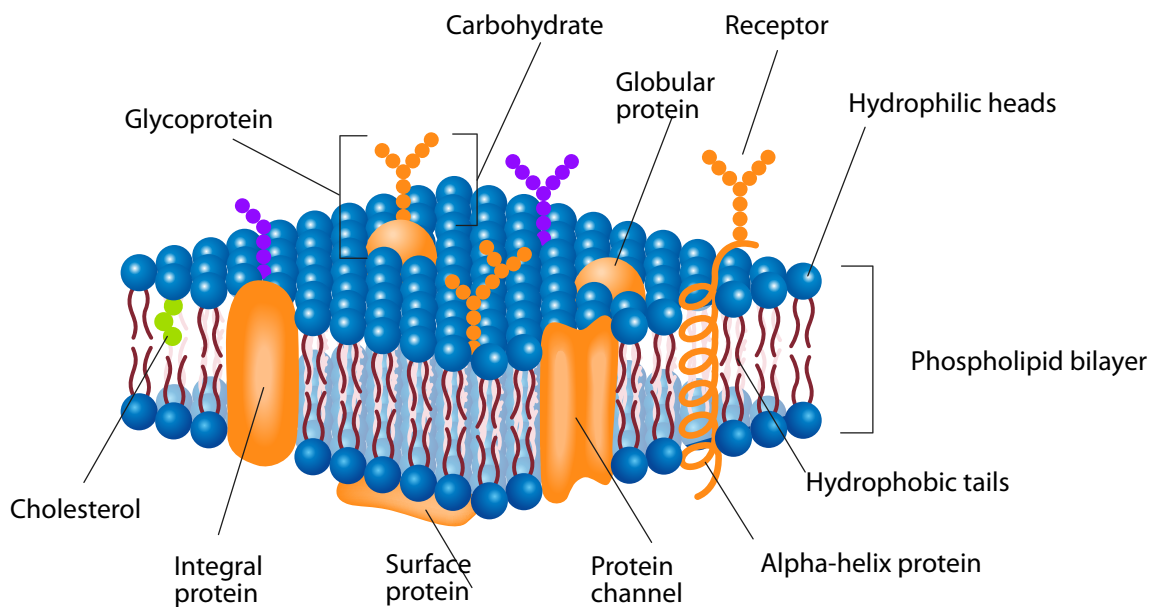
Substance that has a higher concentration inside      potassium ions, magnesium ions

Substance that has a higher concentration outside      sodium ions, chloride ions, calcium ions

3. Label the key next to the diagram below to show the location of *starch*, *cellulose*, *water*, *protein* and *nucleic acids* in the cell. On the cell diagram label the location of *lipids*.



4. (a) Label the features of the fluid mosaic model of the Cell membrane shown below.



- (b) State 3 functions of the cell membrane.

Separate contents of the cell from the external environment.  
 Regulate passage of materials into and out of the cell.  
 Enable cells to recognise one another, and to recognise certain substances, such as hormones.  
 Enable attachment of the cytoskeleton.

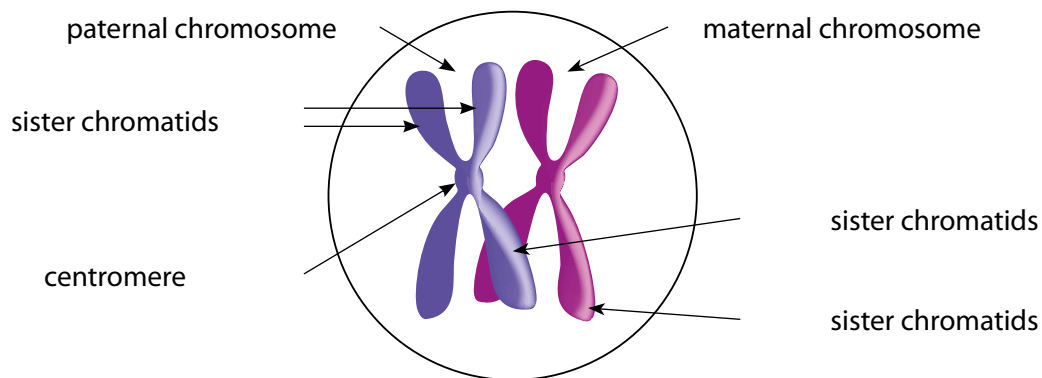
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## Sexual Reproduction and Meiosis

Subject Outline terms and phrases

**diploid, haploid, homologous, meiosis, crossing over, independent assortment, fertilisation, genetic variation, sexual reproduction**

- How many types of autosome are present in a normal **diploid** human cell? 22
  - How many of each type of autosome are present in a normal diploid human cell? 2
- Label the diagram below showing a pair of homologous chromosomes as they would appear while crossing over during late prophase I. Label the following features on your diagram: *centromere, sister chromatids, chiasma, maternal chromosome and paternal chromosome*

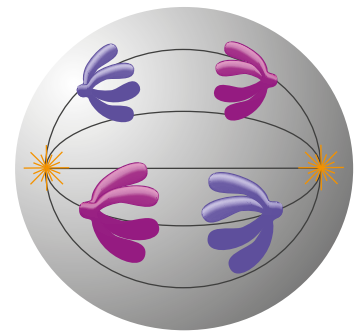


- Describe what is happening during anaphase I.

During anaphase homologous chromosomes are moved apart, going to opposite poles.

- Describe how a second diagram could be drawn (and compared to the diagram in part (a)) to illustrate the idea of independent assortment.

Instead of one maternal and one paternal chromosome going to each pole, two maternal could be shown moving to one pole and two paternal going to the other pole.



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# The Nervous System

Subject Outline terms and phrases

**central nervous system (CNS), peripheral nervous system (PNS), sensory neuron, interneuron, motor neuron, nerve pathway, synapse, neurotransmitter, reflex response**

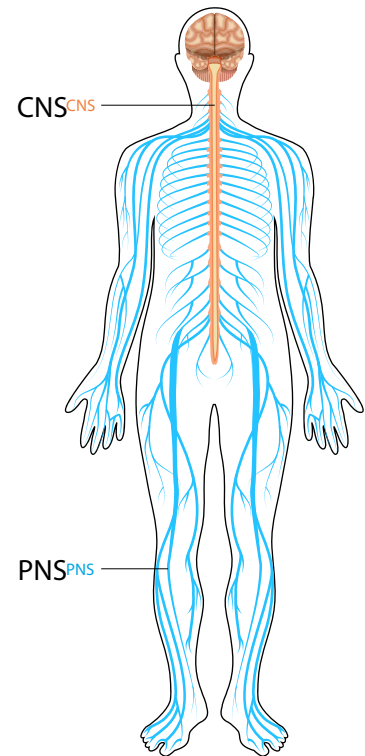
1. (a) On the diagram label the **central nervous system (CNS)** and the **peripheral nervous system (PNS)**.

- (b) State three functions of the CNS.

The role of the CNS is to detect internal changes in the brain, receive stimuli from peripheral nerves, process information, and send nerve impulses to relevant tissues and organs to bring about a response.

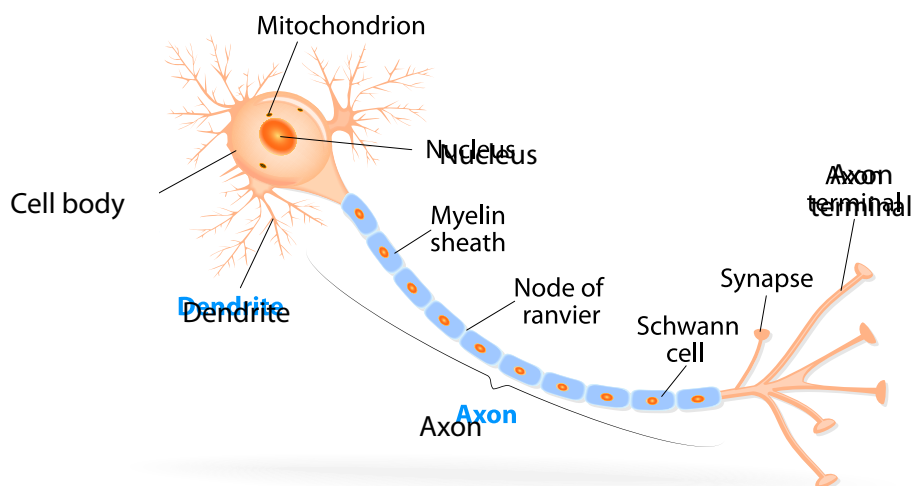
- (c) Name the two parts of the PNS and state which part of the body each one controls.

The peripheral nervous system is made up of the somatic nervous system (SNS) and the autonomic nervous system (ANS). The SNS controls skeletal muscles and is 'voluntary'. The ANS controls things you don't have to think about, such as gut movement, heart rate, and breathing. It is 'involuntary'. The ANS also plays a role in the 'fight or flight' response.



2. On the diagram below, label the following structures:

*cell body, dendrite, nucleus, axon, axon terminal*





5. (a) What is a **synapse**?

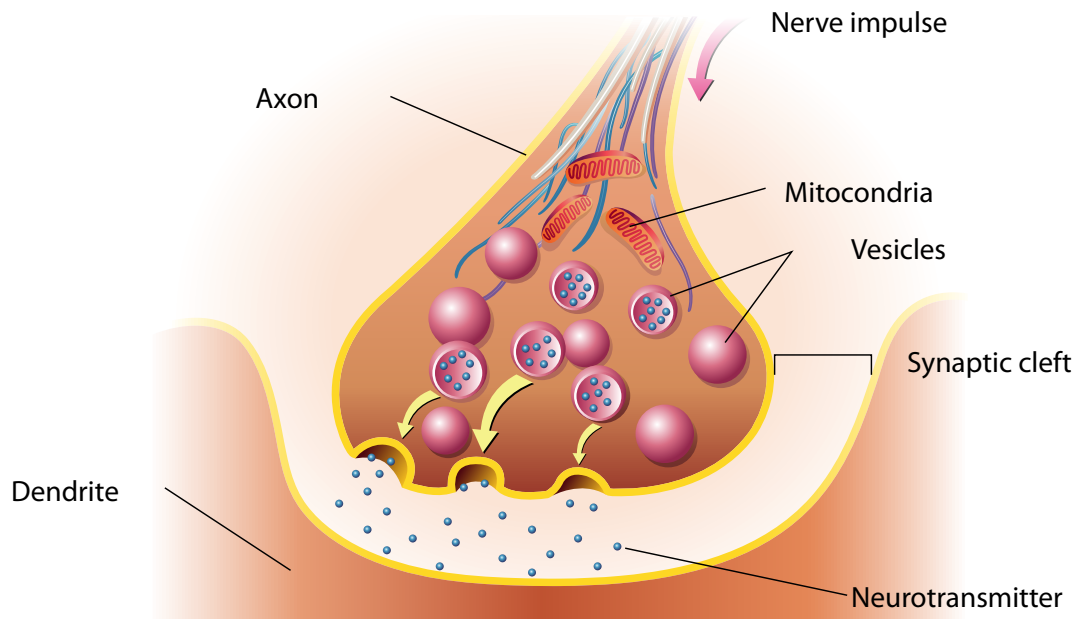
the junction between an axon of one neuron and the dendrite of the next.

(b) What is a **neurotransmitter**? Give two examples.

a chemical secreted by the axon terminal of a neuron into the synaptic cleft at the synapse that initiates a nerve impulse in the next neuron in the nerve pathway.

Examples of neurotransmitters include acetylcholine, dopamine, noradrenaline, and even some amino acids and small peptides.

(c) Label the Synapse diagram below with the following: *Nerve Impulse*, *Mitochondria*, *Synaptic Cleft*, *Neurotransmitter*, *Axon*, *Vesicle*, *Dendrite*,



(d) (i) Why is it important that neurotransmitters do not remain in the synaptic cleft?

If a neurotransmitter, such as acetylcholine, remained in the synaptic cleft it would cause continual stimulation of the next neuron in the pathway or the effector.

(ii) How are neurotransmitters removed from the synaptic cleft?

Following their secretion neurotransmitters are either destroyed by an enzyme, diffuse away quickly, or are absorbed by the cell that secreted them.

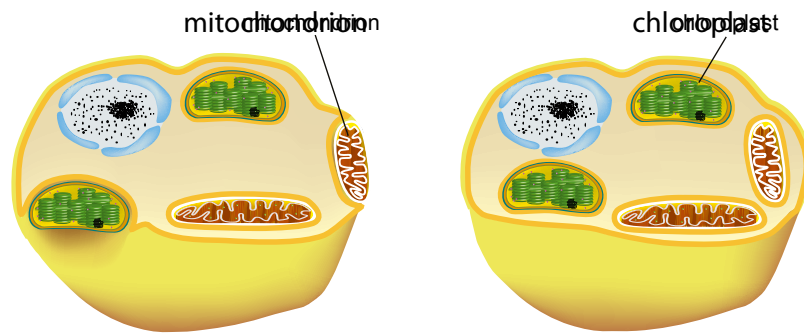
6. (a) What is meant by the term **reflex response**?

an automatic reaction to a stimulus that does not necessarily involve the brain.

(b) State three examples of a reflex response in humans.

knee-jerk reflex, removing hand from hot object, opening and closing of the iris, swallowing reflex.

- (b) Explain how endosymbiotic events may have led to the formation of the first eukaryotic cells. In your answer you should refer to the following diagram, on which you should put suitable labels.



The larger prokaryote cell engulfs (some) smaller prokaryotic cell(s). Some of these smaller cells could respire aerobically, while others were able to photosynthesise. The new 'super-cell' could then carry out more functions than its component cells could do on their own.

- (c) State four pieces of evidence that support the idea that the first eukaryotic cells were formed by endosymbiotic events.
- (1) Chloroplasts and mitochondria have their own DNA, which resembles prokaryotic DNA.
  - (2) Chloroplasts and mitochondria contain their own ribosomes, which resemble bacterial ribosomes.
  - (3) Chloroplasts and mitochondria are able to self-replicate in a process similar to binary fission.
  - (4) Chloroplasts and mitochondria have two membranes that are distinctly different from one another. The outer membrane is similar to the host cell's plasma membrane, while the inner membrane contains proteins similar to those found in bacterial membranes. ribosomes.

4. (a) Explain how the first membranes may have formed spontaneously, eventually giving rise to simple cells.

Some organic molecules were fatty acid chains that probably gave rise to simple membranes in the form of primitive vesicles. See Textbook p164 fig. 20.5.

- (b) Describe the possible roles of RNA and **ribozymes** in the first simple cells.

It is likely that the very first simple cells used RNA as genetic material.

Under certain circumstances RNA can catalyse chemical reactions - like enzymes do. RNA molecules with this ability are called ribozymes.

- (c) Explain why proteins were not used as enzymes in the first primitive cells.

Proteins did not exist, as there was no means of making them at that time.

# 23

## Gene Pools and Natural Selection

Subject Outline terms and phrases

**gene pool, natural selection, adapted, selection pressure, frequency of alleles, genetic drift, genetic diversity**

1. Define the term **gene pool**. (review Chapter 21)

The total of all the genes of all the individuals in a population.

2. What reasoning did Thomas Malthus use to show that not all offspring in natural populations survive to reproduce?

Even the slowest reproducer of the animal world - the elephant - would overrun the world in a few thousand years, if left to reproduce unchecked. This has not happened, indicating that not all the offspring survive to reproduce.

3. State why most natural populations of organisms do not increase in size, but remain fairly constant from one year to the next.

Not all offspring survive to reproduce. A range of agents limits the population size.  
(See answer to Q4.)

4. List four factors that restrict the size of a natural population. (any of the factors listed below)

- |                                       |                           |
|---------------------------------------|---------------------------|
| (1) disease                           | predators                 |
| (2) competition within the population | environmental temperature |
| (3) food availability                 | water availability        |
| (4) shelter                           |                           |

5. Explain why genetic variability is an advantage to a population.

This makes it more likely that at least some members of the population will survive if the environmental conditions change. If there was no genetic variability then it is likely that either all population members would survive, or that all would die.

6. (a) State one example of a genetically controlled characteristic that may *increase* an individual *human's* chances of survival and reproduction.

Resistance to disease, ability to produce gametes.

- (b) State one example of a genetically controlled characteristic that may *decrease* an individual *rabbit's* chances of survival and reproduction.

Coat colour not providing camouflage, lack of resistance to disease, inability to burrow.