

Foundations of Genetic Material

IB Biology - A1.2 Nucleic acids | Level: SL core | Suggested time: 40 minutes

Assessment pattern Multiple choice Short answer Data response Extended response	Total marks 27 Coverage SL focus with integrated application	Syllabus focus • A1.2.1 DNA as the genetic material of all living organisms • Genes, proteins and cell identity • Viruses as non-living particles using host cells
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Instructions

- Answer all questions unless your teacher tells you otherwise.
- Show biological reasoning clearly in short-answer, data-response and extended-response items.

Section A - Multiple choice

Choose the best answer in each case.

1. Which molecule provides the long-term stored genetic information for living organisms? [1]
 - A. ATP
 - B. DNA
 - C. Protein
 - D. Lipid
2. Why are viruses not considered living organisms in this context? [1]
 - A. They contain too many proteins.
 - B. They cannot metabolize or reproduce independently outside host cells.
 - C. They always contain RNA instead of DNA.
 - D. They are too small to be cells.
3. What do the sequences of nitrogenous bases in DNA form? [1]
 - A. Genes carrying coded information
 - B. Cell walls
 - C. Ribosomes
 - D. Phospholipid layers
4. Why can liver cells and nerve cells behave differently even though they contain the same DNA? [1]
 - A. They have different chromosomes.
 - B. They express different parts of the same DNA.
 - C. Only nerve cells contain genes.
 - D. Liver cells contain RNA instead of DNA.
5. A mutation that affects evolution must occur in which molecule if it is to be inherited? [1]

- A. Cellulose
- B. DNA
- C. Water
- D. Ribose

Section B - Short answer

6. Define DNA and state its role in heredity. [2]
7. Explain why DNA is described as universal evidence for common ancestry. [3]
8. Explain why the existence of RNA viruses does not contradict the statement that DNA is the genetic material of all living organisms. [3]

Section C - Data response / case study

9. Data response - Same DNA, different cell function [8]

Researchers examined three cell types taken from the same mammal and measured which protein groups were being produced at a given moment.

Table 1. Protein production in three cell types

Cell type	DNA in nucleus	Main protein group detected	Main role of the cell
Skeletal muscle cell	Present	Contractile proteins	Movement
Pancreatic cell	Present	Digestive enzymes	Secretion
Neuron	Present	Membrane channel proteins	Impulse transmission

- 9(a) State one pattern shown in the table. [2]
- 9(b) Explain how the same DNA can give rise to different cell functions in these cells. [3]
- 9(c) Suggest why DNA must be replicated accurately before cell division in these tissues. [3]

Section D - Extended response

10. Explain how DNA allows hereditary information to be stored and used in cells. [6]

Foundations of Genetic Material - Answer key and marking guidance

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General marking guidance

- Award credit for clear biological meaning even if wording differs from the model answer.
- Do not award more than the maximum marks shown for each question.
- For extended responses, reward linked explanation rather than isolated word lists.

Multiple choice answers

Q	Answer	Why it is correct
1	B	DNA is the long-term hereditary material in all living organisms.
2	B	Viruses have no independent metabolism and only become active inside living host cells.
3	A	The order of bases along DNA stores genetic messages called genes.
4	B	Different cell types use different genes, so they synthesize different proteins.
5	B	Heritable mutations are changes in DNA sequence that can be passed to the next generation.

Short answer and data response guidance

6. Define DNA and state its role in heredity. [2]

- DNA stands for deoxyribonucleic acid.
- It stores hereditary/genetic information that can be copied and passed to daughter cells or offspring.

Marking guidance: Award 1 mark for the full name and 1 mark for a correct role in heredity.

7. Explain why DNA is described as universal evidence for common ancestry. [3]

- All living organisms use DNA as their hereditary material.
- This suggests they share an ancient common origin.
- Differences between organisms arise from different DNA sequences rather than different hereditary molecules.

Marking guidance: Award 1 mark per valid linked point, max 3.

8. Explain why the existence of RNA viruses does not contradict the statement that DNA is the genetic material of all living organisms. [3]

- Viruses are not considered living organisms.

- Some viruses use RNA, but only become active inside living cells.
- All living cells still use DNA as their long-term hereditary material.

Marking guidance: Award up to 3 marks for a clear distinction between living organisms and viruses.

9(a). State one pattern shown in the table. [2]

- All three cell types contain DNA in the nucleus.
- Different cell types mainly produce different protein groups.
- Protein production is linked to cell function.

Marking guidance: Award 1 mark for one valid pattern statement, max 2 if two clear patterns are given.

9(b). Explain how the same DNA can give rise to different cell functions in these cells. [3]

- All cells contain the same DNA/genes.
- Different cell types express/use different genes.
- This leads to synthesis of different proteins, giving different functions.

Marking guidance: Award 1 mark per linked explanatory point, max 3.

9(c). Suggest why DNA must be replicated accurately before cell division in these tissues. [3]

- Each daughter cell needs a complete copy of the genetic information.
- Accurate copying helps maintain the correct proteins/cell functions.
- Errors/mutations could alter cell structure or function.

Marking guidance: Award up to 3 marks for a clear explanation linked to heredity or cell function.

Extended response guidance

10. Explain how DNA allows hereditary information to be stored and used in cells. [6]

- DNA stores information in the sequence of nitrogenous bases.
- Genes are sections of DNA carrying coded instructions.
- These instructions specify amino acid sequences/proteins.
- Proteins determine much of a cell's structure and function.
- DNA is copied before cell division so information can be passed on.
- Different cells use different genes, allowing specialized functions.

Marking guidance: Award up to 6 marks for linked explanation from DNA sequence to proteins and heredity.