

GCSE Combined Science: Trilogy

Worksheet: DNA and the genome

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: DNA and the genome

NAME	CLASS	DATE
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

DNA carries the genetic information of an organism.

0 1 . 1 Name the structures in a cell's nucleus that contain most of an organism's DNA.

.....

.....

.....

.....
[1 mark]

0 1 . 2 Which of these is the smallest unit?

Tick (✓) **one** box.

Chromosome

☐

Gene

☐

Genome

☐

Nucleus

☐

[1 mark]

0 1 . 3

Which type of human cell has no nucleus, and so contains no chromosomes?

.....

.....

.....

.....

[1 mark]

0 1 . 4

Which **two** of these are reasons why scientists study the human genome?

Tick (✓) **two** boxes.

To change a person's blood group

☐

To search for genes linked to disease

☐

To speed up the digestion of protein

☐

To trace human migration patterns from the past

☐

[2 marks]

0 2

The genetic material in the nucleus of a cell is found in chromosomes.

0 2 . 1

What chemical is the genetic material in the nucleus made of?

Tick (✓) **one** box.

DNA

☐

Glucose

☐

Lipid

☐

Starch

☐

[1 mark]

0 2 . 2

DNA is a polymer made of two strands.

What name is given to the shape of a DNA molecule?

.....

.....

.....

.....

[1 mark]

0 2 . 3

Write the words **chromosome**, **gene** and **genome** in order of size, starting with the smallest.

.....

.....

[1 mark]

0 2 . 4

What is a gene?

.....

.....

.....

.....

[2 marks]

.....

0 3

Scientists have sequenced the entire human genome.

0 3 . 1

Explain what is meant by the genome of an organism, and describe why scientists want to study the human genome.

.....

.....

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.....

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.....

.....

[6 marks]

0 4

Some medicines work well for some patients but cause side effects or do not work for others, partly because of differences in their genomes.

0 4 . 1

Suggest how knowing a patient's genome could help doctors prescribe medicines more effectively.

.....

.....

.....

.....

[2 marks]

0 4 . 2

Suggest **one** practical difficulty of using genome information in this way for every patient.

.....

.....

[1 mark]

0 5

Table 1 shows the approximate cost of reading (sequencing) the whole genome of one person in different years.

Table 1

Year	2001	2007	2011	2015	2022
Approximate cost in £	60 000 000	6 000 000	8000	1000	500

0 5 . 1

Calculate how many times more expensive it was to sequence one genome in 2001 than in 2022.
Give your answer in standard form.

.....

.....

.....

.....

.....
[2 marks]

0 5 . 2

Suggest **two** ways in which cheaper genome sequencing could help doctors.

.....

.....

.....

.....

[2 marks]

0 5 . 3

To search for genes linked to a disease, scientists compared the genomes of 5000 people with the disease and 5000 people without it.
Explain why they needed to study so many people.

[2 marks]

0 6

The whole human genome has now been studied.

0 6 . 1

What is meant by the genome of an organism?

[1 mark]

0 6 . 2

Give **three** reasons why studying the human genome is important.

[3 marks]

0 6 . 3

Scientists found that women with a particular allele of one gene have a much higher risk of developing breast cancer.
Suggest how this discovery could be used to help people.

.....

.....

.....

.....

[2 marks]

0 6 . 4

Suggest **one** concern that people may have about genetic testing.

.....

.....

[1 mark]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: DNA and the genome · 32 marks

Question 1 (5 marks)

01.1 [1 mark]

Answer: Chromosomes

- chromosomes (1)
-

01.2 [1 mark]

Correct: Gene

01.3 [1 mark]

Answer: A (mature) red blood cell

- (mature) red blood cell (1)
-

01.4 [2 marks]

Correct: To search for genes linked to disease; To trace human migration patterns from the past

Question 2 (5 marks)

02.1 [1 mark]

Correct: DNA

02.2 [1 mark]

Answer: Double helix

- double helix (1)
-

02.3 [1 mark]

Answer: Gene, chromosome, genome

- gene, chromosome, genome (1)
-

02.4 [2 marks]

Answer: A small section of DNA on a chromosome that codes for a particular sequence of amino acids, to make a specific protein

- a (small) section of DNA (on a chromosome) (1)
 - that codes for a particular sequence of amino acids / a specific protein (1)
-

Question 3 (6 marks)

03.1 [6 marks]

Levels of response

- **Level 3 (5–6)** A detailed, coherent answer. Relevant points are accurate, linked in a logical sequence and use correct scientific terms.
- **Level 2 (3–4)** Several relevant points with some linking, but the answer has gaps, errors or lacks detail.
- **Level 1 (1–2)** Simple statements making one or two relevant points, with little or no linking.
- **No marks (0)** Nothing relevant or worthy of credit.

Indicative content

- the genome of an organism is the entire genetic material of that organism (all of its DNA)
- DNA is a polymer made of two strands forming a double helix, found in structures called chromosomes
- a gene is a small section of DNA on a chromosome that codes for a particular sequence of amino acids, to make a specific protein
- studying the human genome allows scientists to search for genes linked to different types of disease
- this can help scientists to understand and treat inherited disorders, e.g. by earlier diagnosis or developing new treatments
- it can be used to trace human migration patterns from the past, by comparing the genomes of people from different parts of the world
- comparing the human genome with the genomes of other species shows how closely related they are / helps to trace evolutionary relationships

Notes: Level 3 (5–6 marks): gives an accurate definition of genome AND at least two distinct, correctly explained reasons for studying the human genome. Level 2 (3–4 marks): a partial definition or one clearly explained reason, with some gaps. Level 1 (1–2 marks): simple, isolated correct facts about DNA or genes, with little development.

Question 4 (3 marks)

04.1 [2 marks]

Answer: Doctors could choose the medicine and dose most likely to work well and cause the fewest side effects for that patient's genetic make-up, rather than using the same treatment for everyone

- doctors could choose the medicine and/or dose most likely to work well (and cause fewest side effects) for that particular patient's genetic make-up (1)
- rather than using the same treatment for every patient (1)

04.2 [1 mark]

Answer: Genome sequencing can be expensive and take time, and not every clinic may have the necessary equipment or expertise

- genome sequencing / testing can be expensive and take time, and not every clinic has the necessary equipment or expertise / storing sensitive genetic data raises privacy concerns (1)
-

Question 5 (6 marks)

05.1 [2 marks]

Answer: 1.2×10^5

- $60\,000\,000 \div 500 (= 120\,000)$ (1)
- 1.2×10^5 (1)

Notes: Correct answer with no working scores 2 marks. 120 000 (not in standard form) scores 1 mark.

05.2 [2 marks]

Answer: Searching for genes linked to diseases, and understanding and treating inherited disorders

- searching for genes linked to different types of disease (1)
- diagnosing / understanding and treating inherited disorders (1)
- choosing the medicine or dose most likely to work for a particular patient (1)

Any 2 of the points above.

05.3 [2 marks]

Answer: They were looking for DNA variants that are more common in people with the disease than in people without it; with large samples, a difference is less likely to be due to chance

- to find (DNA) variants that are more common in people with the disease than in people without it (1)
 - large samples make it less likely that a difference is due to chance / make the results more reliable (1)
-

Question 6 (7 marks)

06.1 [1 mark]

Answer: The entire genetic material of that organism

- the entire / all the genetic material of the organism (1)

06.2 [3 marks]

Answer: To search for genes linked to different types of disease; to understand and treat inherited disorders; to trace human migration patterns from the past

- searching for genes linked to (different types of) disease (1)
- understanding and treatment of inherited disorders (1)
- tracing human migration patterns from the past (1)

06.3 [2 marks]

Answer: Women could be tested for the allele; those with it could have more frequent check-ups or preventive treatment so any cancer is found early; drugs could be developed that target the faulty protein

- people can be tested / screened for the allele (1)
- people with the allele can have regular check-ups / screening so cancer is detected early (1)
- people with the allele could choose preventive treatment / make lifestyle changes (1)
- new treatments / drugs could be developed that target the effects of the allele (1)

Any 2 of the points above.

06.4 [1 mark]

Answer: Insurance companies or employers might discriminate against people with a high-risk allele

- discrimination by insurers / employers / anxiety about a result for a disease that may never develop / privacy of genetic data (1)
-