

# GCSE Biology

## Worksheet: DNA and the genome

|                       |                          |                              |                                   |
|-----------------------|--------------------------|------------------------------|-----------------------------------|
| TIME<br><b>35 min</b> | TOTAL<br><b>32 marks</b> | CALCULATOR<br><b>Allowed</b> | DIFFICULTY<br><b>Easy, Medium</b> |
|-----------------------|--------------------------|------------------------------|-----------------------------------|

**Topics:** DNA and the genome

|             |              |             |
|-------------|--------------|-------------|
| <b>NAME</b> | <b>CLASS</b> | <b>DATE</b> |
|-------------|--------------|-------------|

- 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]

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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

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 3 . 1

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

.....

.....

.....

.....

[2 marks]

0 3 . 2

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

.....

.....

[1 mark]

0 4

The whole human genome has now been studied.

0 4 . 1

What is meant by the genome of an organism?

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[1 mark]

0 4 . 2

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

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[3 marks]

0 4 . 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.

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[2 marks]

0 4 . 4

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

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[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

Scientists have sequenced the entire human genome.

0 6 . 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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.....

[6 marks]

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**END OF QUESTIONS**

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

# Mark scheme

## GCSE Biology · Worksheet: DNA and the genome · 32 marks

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### Question 1 (5 marks)

01.1 [1 mark]

**Answer:** Chromosomes

- chromosomes (1)
- 

01.2 [1 mark]

**Correct:** Gene

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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

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### Question 2 (5 marks)

02.1 [1 mark]

**Correct:** DNA

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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)
-

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### Question 3 (3 marks)

#### 03.1 [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)

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#### 03.2 [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)
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## Question 4 (7 marks)

### 04.1 [1 mark]

**Answer:** The entire genetic material of that organism

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

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### 04.2 [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)

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### 04.3 [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.

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### 04.4 [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)
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## Question 5 (6 marks)

### 05.1 [2 marks]

**Answer:**  $1.2 \times 10^5$

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

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

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### 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.

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### 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)
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## Question 6 (6 marks)

### 06.1 [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.

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