Chromosomes

4.1.2.1 · Cell biology · revision notes

What chromosomes are, how they relate to DNA and genes, and how they are arranged in body cells. Questions are usually short: recall, putting structures in size order, and working out chromosome numbers.

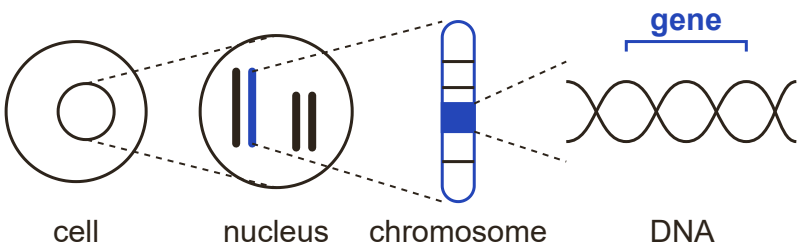
Key facts

- Chromosomes are found in the nucleus
- Gene = a small section of DNA on a chromosome that codes for a particular protein
- Body cells: chromosomes in pairs (humans: 23 pairs = 46)
- Size: cell > nucleus > chromosome > gene
- Chromosome = a long, coiled molecule of DNA
- Each chromosome carries a large number of genes
- Gametes: one chromosome from each pair (humans: 23)

Notes

Chromosomes, DNA and genes

- The nucleus of a cell contains **chromosomes**.
- Chromosomes are made of **DNA** molecules. Each chromosome is a very long DNA molecule, tightly coiled.
- Each chromosome carries a large number of **genes**. A gene is a small section of DNA that codes for a particular protein.
- Size order, largest first: cell → nucleus → chromosome → gene.



Cell → nucleus → chromosome → gene. A gene (blue) is a small section of the DNA in a chromosome.

Chromosomes come in pairs

- In body cells, chromosomes are normally found in **pairs**.
- Human body cells contain 23 pairs of chromosomes: 46 in total.
- One chromosome of each pair came from the mother (in the egg) and the other from the father (in the sperm).
- Gametes (sperm and egg cells) contain only one chromosome from each pair: 23 in humans. When a sperm and an egg join at fertilisation, the pairs form again.
- Different species have different numbers of chromosomes. For example, a dog body cell has 78 (39 pairs).

Why this matters

- Before a cell divides by mitosis, each chromosome is copied, so each new cell gets a full set of chromosome pairs.
- Genes on chromosomes are passed from parents to offspring, which is why offspring share features with their parents.

How to answer each type of question

Put structures in order of size 1 mark **Grade 4**

1. Remember that each structure contains the next: a cell contains a nucleus, a nucleus contains chromosomes, a chromosome carries genes.
2. Check the question: largest first or smallest first?

Example. Put these structures in order of size, starting with the largest.
chromosome, gene, nucleus, cell

Model answer. cell, nucleus, chromosome, gene (1)

Describe how DNA, genes and chromosomes are related 2 to 3 marks **Grade 5**

1. Say what chromosomes are made of (DNA).
2. Say what a gene is (a small section of DNA).
3. Say how many genes a chromosome carries (a large number).

Example. Describe how genes, chromosomes and DNA are related.

Model answer. Chromosomes are made of DNA (1). A gene is a small section of DNA (1). Each chromosome carries a large number of genes (1).

Work out chromosome numbers

1 to 2 marks | Grade 5

1. Pairs × 2 = total number of chromosomes in a body cell.
2. A gamete has one chromosome from each pair, so it has the same number as there are pairs.

Example. A cat body cell has 19 pairs of chromosomes.
(a) How many chromosomes are in a cat body cell?
(b) How many chromosomes are in a cat sperm cell?

Model answer.

(a) 38 (1)
(b) 19 (1)

Explain why chromosomes are in pairs

2 marks | Grade 6

1. Say where each chromosome of a pair came from.
2. Link this to the sperm and egg joining at fertilisation.

Example. Explain why the chromosomes in human body cells are found in pairs.

Model answer. One chromosome of each pair is inherited from each parent (1). The sperm and the egg each carry one chromosome from each pair, and they join at fertilisation (1).

Don't lose marks

- Saying a chromosome is a gene, or that a gene contains chromosomes. Genes are sections of a chromosome.
- Saying humans have 46 pairs of chromosomes. It is 23 pairs, 46 in total.
- Saying gametes have 23 pairs. They have 23 single chromosomes.
- Saying chromosomes are in the cytoplasm of animal or plant cells. They are in the nucleus.

More tips

Memory tricks

- Size order: 'Cats Never Chase Geese' = Cell, Nucleus, Chromosome, Gene.
- Think of a chromosome as a book and its genes as the chapters: one book, many chapters, all written in DNA.
- Pairs: one chromosome from mum, one from dad.

Exam technique

- Use 'DNA', 'gene' and 'chromosome' precisely: examiners do not accept them as meaning the same thing.
- Read carefully whether the question asks for the number of pairs or the total number of chromosomes.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

State where chromosomes are found

In the nucleus of a cell.

Grade 4

Describe what chromosomes are made of

Chromosomes are made of DNA, and each chromosome carries a large number of genes.

Grade 4

State the chromosome number in human cells

Body cells have 23 pairs (46 in total); sperm and egg cells have 23 single chromosomes.

Grade 4

Link genes to proteins

A gene is a small section of DNA that codes for a particular protein.

Grade 5

Put cell, nucleus, chromosome and gene in order

Largest to smallest: cell, nucleus, chromosome, gene.

Grade 6

Explain why body cell chromosomes are paired

One chromosome of each pair came from each parent, in the egg and the sperm.

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