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DNA and the genome

2 Quick quiz

Complete the following sentences. Use words from the box.

chromosomes DNA helix nucleus polymer two genetic

The material in a cell is composed of a chemical called

This chemical is a because it is made of repeating units.

The units are joined together to make strands, which twist round each other forming a double The strands combine with other molecules to form structures called

5 Genes and genome Grade 4

1. The human genome consists of about 20 000 genes.

(a) Give the meaning of the term 'human genome'. [1 mark]

.....

(b) Give the meaning of the term 'gene'. [2 marks]

 A small section of DNA that

Remember that genes are found on chromosomes.

10 The human genome Grades 7–8

2. Many complete human genomes have been mapped to show their DNA structure.

(a) This work has shown many small differences between the genomes of different people caused by mutations. Give the meaning of the term 'mutation'. [1 mark]

.....

(b) Analysis of genomes from people all over the world indicates that all non-African people today are descendants of one small group of humans who left Africa around 70 000 years ago. Suggest the evidence for this from genome analysis. [2 marks]

.....
.....

(c) Once the genome has been mapped, the genes can then be identified. Explain how looking at the detail of a gene can help identify people who are at risk of developing an inherited disorder. [2 marks]

.....
.....

(d) Describe **one** advantage for a person of knowing their risk of developing a particular disease. [1 mark]

.....

(e) Suggest **one** disadvantage for a person of knowing their risk of developing a particular disease. [1 mark]

.....



Genetic inheritance

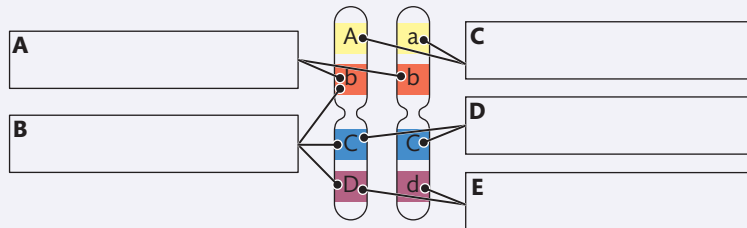


Quick quiz



The diagram shows a pair of chromosomes found in a body cell. Add the following labels to the diagram.

- different genes
- heterozygous allele pair
- homozygous recessive allele pair
- alleles of gene A
- homozygous dominant allele pair



Genetic cross and Punnett squares

Grade 6

1. What do most phenotype features result from? Tick **one** box. [1 mark]

- a single gene multiple interacting genes
- a recessive allele a dominant allele

Phenotype is the observable characteristics of an organism, or its appearance.

2. (a) Cystic fibrosis is a disorder of cell membranes caused by a recessive allele.

State what is meant by the term 'recessive disorder'. [1 mark]

A recessive disorder is caused by

(b) Complete the Punnett square to show the possible genotypes of offspring from parents who are both heterozygous for the gene related to cystic fibrosis. [2 marks]

Start by identifying the father's alleles using information from the question.

Table 1

		Father's alleles	
Mother's alleles	F		
	f		

(c) Use your Punnett square to calculate the probability of a child of these parents developing cystic fibrosis. [1 mark]

probability =

What proportion of the offspring genotypes could develop the disease?

Maths skills

Probability is a measure of how likely something is to happen. Probabilities can be written as ratios, fractions, decimals and percentages.



Inheritance

Grade 6

3. Being able to taste bitter Phenylthiocarbamide (PTC) is caused by a dominant allele, **T**. Having two copies of the recessive allele, **t**, makes a person unable to taste PTC.

(a) Complete the Punnett square to show the genotypes of the offspring from a father who is heterozygous for the PTC gene and a mother who cannot taste PTC. [2 marks]

Table 2

		Father's alleles	
Mother's alleles			

(b) Use your completed square to calculate the probability of a child inheriting the inability to taste PTC from these parents. Give the probability as a percentage. [1 mark]

..... %





Copyrighted Material Inherited disorders

2 Quick quiz

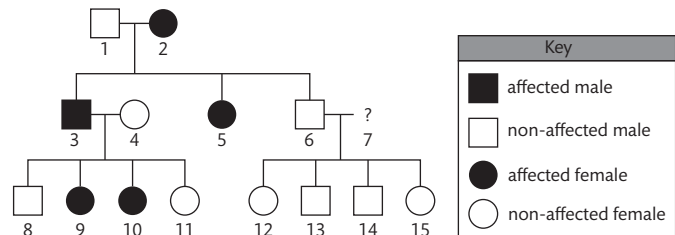
Draw **one** line from each word to link it to its meaning.

- inherited disorder
- recessive allele
- dominant allele
- monohybrid inheritance

- affects the phenotype only when there are two copies in the genotype
- inheriting a phenotype caused by a single gene
- a disorder caused by a faulty allele
- affects the phenotype when only one copy is present in the genotype

10 Family pedigree

1. **Figure 1** shows a family pedigree identifying which family members have an inherited disorder caused by a dominant allele.



(a) State how many women shown in **Figure 1** have the disorder. [1 mark]

..... Use the key to help you.

(b) If **A** represents the dominant allele and **a** shows the recessive allele for the disorder, identify the genotype of person 1. Give a reason for your answer. [2 marks]

..... The clue for this is in the introduction of the question.

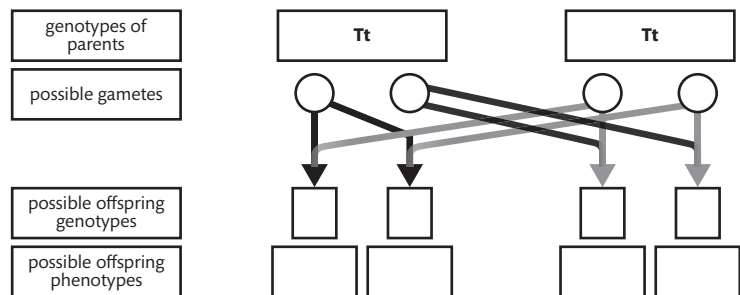
(c) The phenotype of person 7 is not given. Discuss whether person 7 is likely to have the disorder or not. [3 marks]

The children of couple 6/7 are all homozygous recessive so must have inherited a allele from parent 7. This means that person 7 could be

Look at the phenotypes of person 6 and the children of the couple.

10 Genetic diagrams

2. Two pea plants were bred together. Pollen from a plant heterozygous for a gene that affects plant height was transferred to the flowers of another plant heterozygous for the gene. In **Figure 2**, the dominant allele that causes plants to be tall is shown as **T**, and the recessive allele that causes dwarf plants is **t**.



(a) State the phenotype of both parent plants. [1 mark]

.....

(b) Complete the genetic diagram in **Figure 2** to show the alleles in the possible gametes, and the genotypes and phenotypes in the possible offspring. [3 marks]

(c) Use your completed diagram to identify the percentage of seeds produced from this cross that will produce dwarf plants. [1 mark]



Sex determination



Quick quiz



Complete each sentence by choosing the correct terms from the box below.

DNA fertilisation gametes pairs parent XX XY YY genes zygote

The sex of an individual is determined at when the two fuse to form a One of the chromosome pairs in each cell carries that determine the sex of the individual.

In human females, the two sex chromosomes are

In males, the two sex chromosomes are



Sex chromosomes

Grade 5



1. (a) Name the type of cell division that gives rise to the formation of sex cells. [1 mark]

.....

(b) State what proportion of the following gametes contain an X chromosome.

(i) egg cell [1 mark]

(ii) sperm cell [1 mark]

Remember that only one chromosome from each pair enters the gamete during cell division.

(c) The sex of a baby is determined by the inheritance of sex chromosomes. State and explain which parent's sex chromosome determines whether the baby is a girl or a boy. [3 marks]



Egg cells from the mother contain

Sperm cells contain

So it is the whose gamete determines the sex of the baby.



Sex determination

Grade 6



2. (a) Complete the Punnett square diagram to show the inheritance of sex. Use the symbols X and Y for the chromosomes. [2 marks]

Table 1

		Sperm cells from father	
		X	Y
Egg cells from mother	X		
	Y		

(b) A couple are having a baby. Using your Punnett square, determine the chance of the baby being a girl. Tick **one** box. [1 mark]

0% 25% 50% 75%

(c) A different couple already have two boys and a girl, and the woman is pregnant. State the probability that the baby will be a girl. [1 mark]

.....

(d) Explain your answer to part (c). [2 marks]

.....

.....





Variation and mutation

2 Quick quiz

Each statement below describes an example of variation. Circle the correct word after each statement to show if it describes genetic or environmental variation.

- Seeds from tall plants usually produce plants that grow to be tall. **environmental / genetic**
- Seeds from tall plants may not grow tall because they cannot get enough water. **environmental / genetic**
- Seeds from green-leaved plants may occasionally produce plants with very pale leaves that contain little chlorophyll. **environmental / genetic**
- Plants that usually have green leaves may develop pale leaves if grown in the dark. **environmental / genetic**

10 Variation and mutations Grade 6

1. (a) Give the meaning of the term 'variation'. [1 mark]

.....

(b) Give the meaning of the term 'mutation'. [1 mark]

 A mutation is a change in

.....

(c) Explain how mutations may lead to variation. [3 marks]

.....
.....
.....

Phenotype is the appearance of an organism. Genotype is the genetic makeup of an organism – its genes.

(d) A baby may have around 100 mutations in its genes that its parents do not have. Give a reason why the baby still looks like its parents. [1 mark]

 Most or all of the mutations will have no

.....
.....

10 Cause of variation Grades 6–7

2. Human hair colour is inherited through the effects of two interacting genes.

(a) Suggest why there is a wide range of different inherited hair colours in humans. [2 marks]

.....
.....

(b) Explain why children of the same parents may have different hair colour to each other. [2 marks]

.....
.....

(c) Occasionally, parents with fair, brown or black hair have a child who has very pale or white hair. Suggest a reason for the pale-coloured hair. [1 mark]

.....

(d) People with light brown hair may develop paler, fair hair if they spend a lot of time in bright sunshine. Explain why this is an example of environmental variation. [2 marks]

.....
.....





Evolution by natural selection



Quick quiz



Complete the following sentences on Darwin's theory. Use words from the box.

adapted characteristics evolution genes natural selection phenotypes simple offspring

Darwin's theory of describes how organisms may change over time through This explains how changes in the environment can lead to changes in of species as only the best individuals survive and breed, passing on their characteristics to their in their



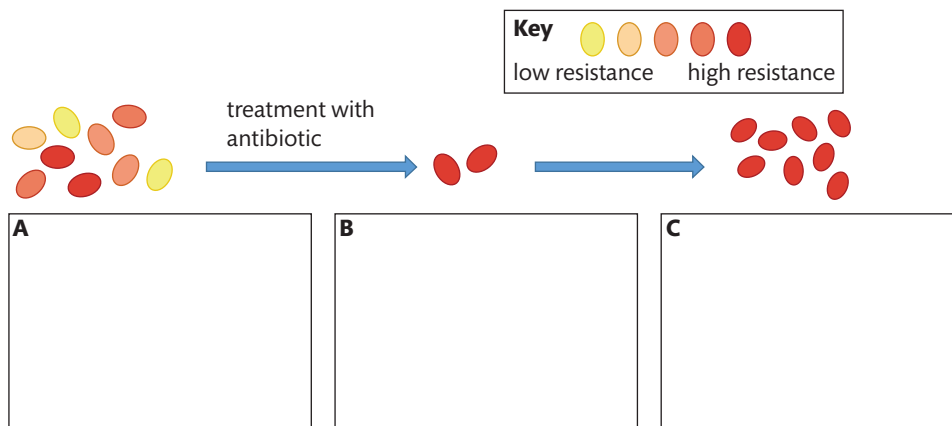
Evolution of resistance

Grade 7



1. One example of evidence for evolution by natural selection is the evolution of antibiotic-resistant bacteria.

Label the diagrams in **Figure 1** to show how this evolution occurs. Each shape is a bacterium. **[3 marks]**



Label **A** should say why there is variation in the population. Label **B** should describe the impact of using antibiotics on the population. Label **C** should say how the population of antibiotic-resistant bacteria then develops.

Figure 1



New species

Grade 6



2. Bonobos and chimpanzees are thought to have evolved from a common ancestor around 2 million years ago. Bonobos live south of the wide Congo river in Africa, while chimpanzees live north of the river. Neither bonobos nor chimpanzees are good swimmers.

Explain how the formation of the Congo river around 2 million years ago could have led to the evolution of the bonobo and chimp species. **[6 marks]**

.....
.....
.....
.....
.....
.....
.....
.....
.....

This answer needs to describe why the DNA of the two groups changed once they were separated from each other.

Exam focus
Remember some marks in a 6-mark question are for the ordering and coherence of your argument.

Continue your answer on your own paper.