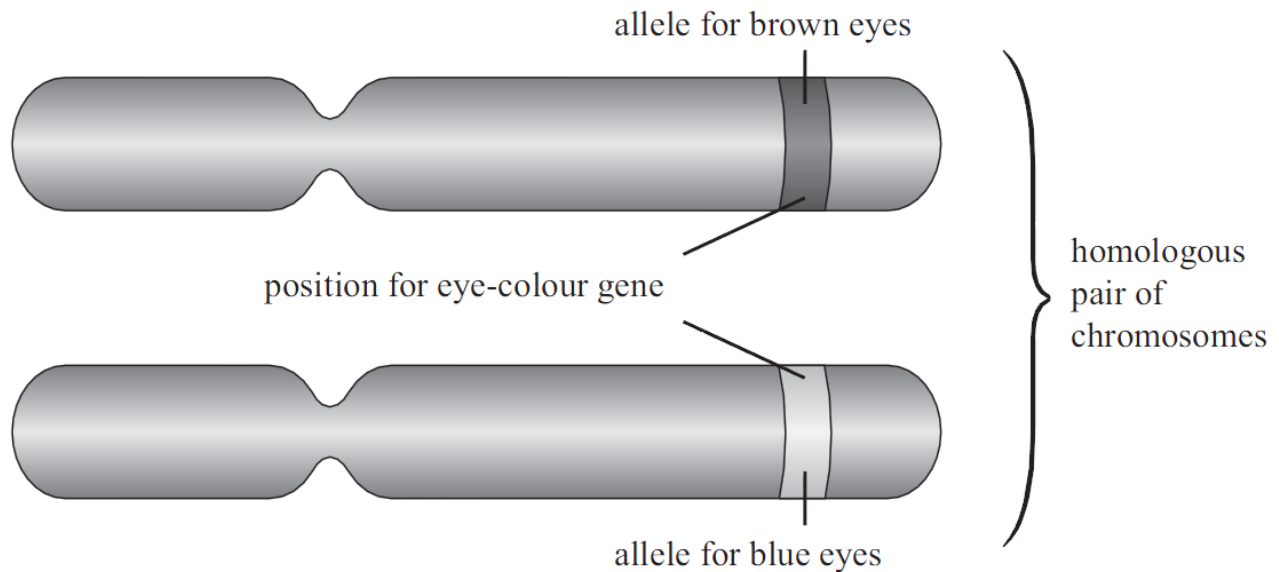


### Collated questions

#### Demonstrate understanding of biological ideas relating to genetic variation

### DNA STRUCTURE

#### THE ROLE OF DNA IN INHERITANCE (2013:2)



- (a) Use the diagram above to help you explain the relationship between chromosomes, genes, alleles, phenotype, genotype, and the molecule DNA.  
A labelled diagram may assist you.
- (b) The allele for brown eyes (B) is dominant over the allele for blue eyes (b) in humans.  
Discuss how it would be possible for a child to have blue eyes, even though both their parents have brown eyes.

In your answer you should:

- use labelled Punnett squares
- link the genotypes and phenotypes of the child, parents, AND grandparents.

### GENETIC STRUCTURE (2012:1)

The diagram below shows the relationship between chromosomes, genes, and DNA (deoxyribonucleic acid).

- (a) Explain the relationships between DNA, chromosomes and genes.  
You may add notes and labels to the diagram above to support your answer.



- (b) Explain how the relationships in your answer to (a) lead to different characteristics and how this contributes to genetic variation.

### DNA AND VARIATION (SAMPLE 2011:1)

Genes determine many of the features of organisms, such as the colour of the flowers on a plant.

A gene is a part of a DNA molecule.

The type of plant shown in the photograph below can have red or white flowers.



Red flowers are due to a dominant allele and white flowers are due to a recessive allele.

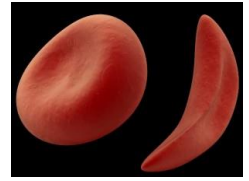
Discuss how information in DNA gives organisms (like the plant above) their individual features, such as red and white flowers. In your answer, you should:

- explain the difference between a gene and an allele
- draw a labelled diagram to show the relationship between a gene and an allele and the structure of a DNA molecule
- explain how the base sequence on DNA determines a particular feature (eg, flower colour) and different forms (variations) of that feature (eg, red and white flowers).

## MONOHYBRID CROSSES

### **PATTERNS OF INHERITANCE (2012:2)**

A blood disorder caused by red blood cells with an unusual curved (sickle) shape is inherited through a single gene with two possible alleles, normal (left) and sickle (right).



Use 'H' to represent the dominant 'normal' allele, and 'h' to represent the recessive 'sickle' allele.

(a) Explain how two parents with normal blood cells can have a child with sickle-shaped blood cells.

In your answer, you should:

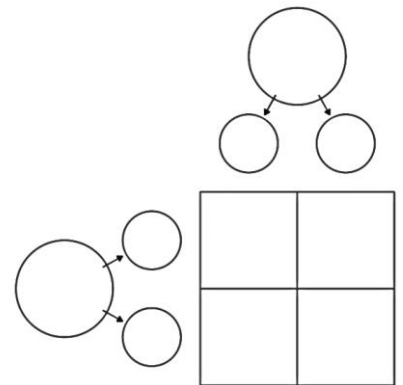
- state the genotype of a child with the sickle-shaped blood cells
- state the genotypes of **both** normal parents
- draw a Punnett square to show how two normal parents can produce a child with sickle-shaped blood cells.

(b) The parents in part (a) have four children all with sickle-shaped blood cells. They are expecting a fifth child.

(i) Explain how normal parents could have produced FOUR children with sickle-shaped blood cells.

You should refer to your Punnett square in (a).

(ii) Explain what the chances are of the fifth child having sickle-shaped blood cells.



### **SQUASH PLANTS (2011:1)**



One trait in squash plants is the colour of the fruit.

White fruit are due to a dominant allele (F) and yellow fruit are due to a recessive allele (f).

(a) Explain the difference between a gene and an allele.

(b) The alleles for the colour of squash fruit combine to produce THREE different genotypes, but only TWO phenotypes.

Explain how the alleles combine to produce only two different squash colours – white and yellow.

In your answer you should:

- define genotype and phenotype
- state the three different genotypes produced and the phenotype of each.

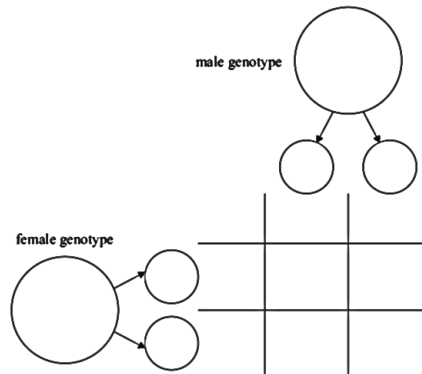
### A GIRL OR A BOY? (2011:3)

A couple are expecting their third child. They already have one boy and one girl.

(a) Discuss the likelihood of their third child being a girl.

In your answer you should:

- explain how sex is determined in humans
- complete a Punnett square showing sex inheritance
- explain the relevance of the couple already having children.



(b) One of the parents is a teacher who developed deafness last year as a result of having noisy classes. Discuss the likelihood of this type of deafness being inherited by the new baby.

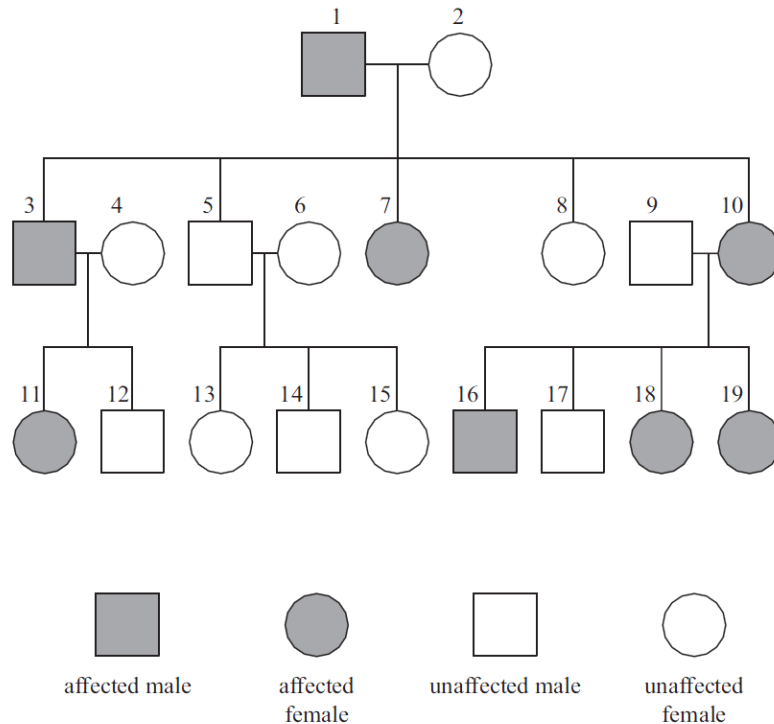
In your answer you should consider:

- the reason for the parent's deafness
- what types of characteristics are inherited
- the effects of genetics and the environment on deafness in offspring.

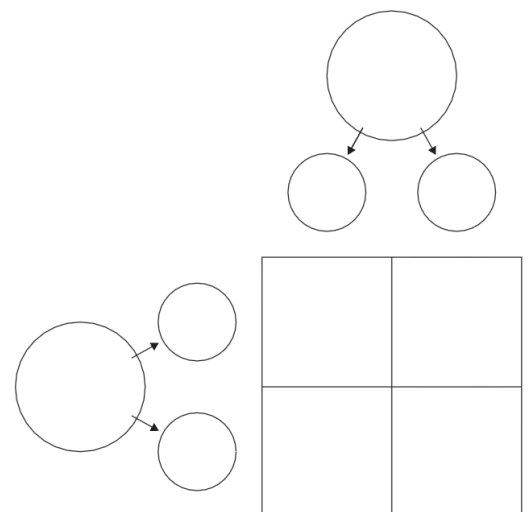
## PEDIGREE CHARTS

### PEDIGREES AND PUNNETT SQUARES (2013:1)

Huntington's disease is a genetic disorder in humans. It is caused by a dominant allele (H). The normal allele is recessive (h).



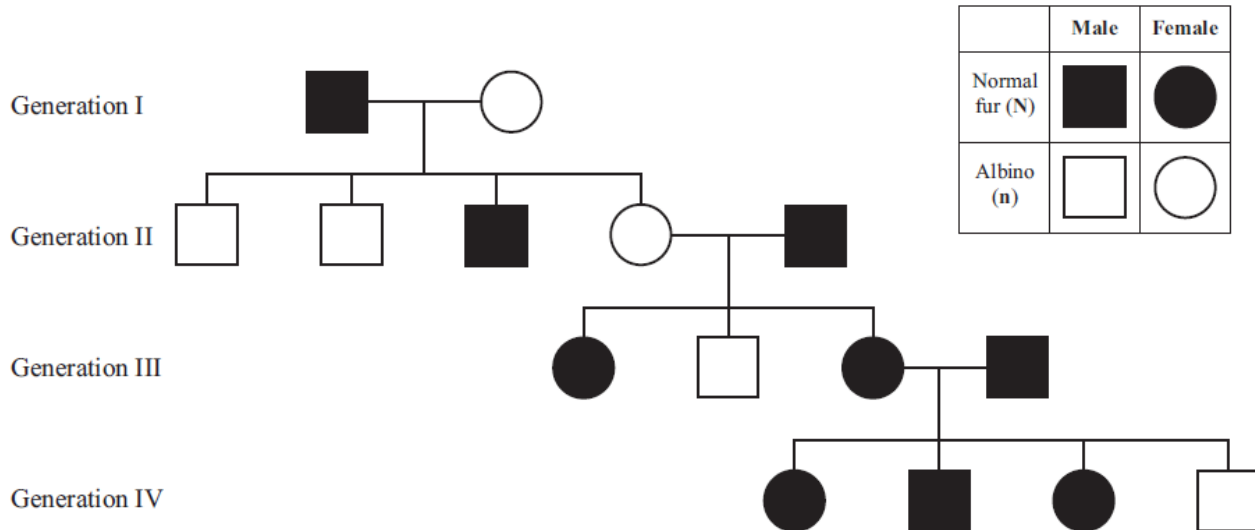
- (a) Using H and h, give the two possible genotypes for an individual who has Huntington's disease:
- (b) State the genotype of individual 9 in the pedigree chart above. State the genotype of individual 10 in the pedigree chart above. Explain how you worked out the genotype for individual 10. You should support your answer using evidence from BOTH the parents AND children of individual 10.
- (c) Draw a Punnett square to show the **possible** genotypes of the children from parents 9 and 10.
- (i) From **your** Punnett square, predict what fraction of the children would have Huntington's disease and what fraction would not have Huntington's disease.
- Fraction of children with Huntington's disease:
  - Fraction of children without Huntington's disease:
- (ii) Using your Punnett square, show the expected phenotype ratio for the children.
- (d) In the pedigree chart the phenotype ratio of Huntington's disease in the children of parents 9 and 10 is not the same as the predicted ratio you have given on the previous page. Give reasons why the predicted ratio in the Punnett square and the observed ratio in the children may NOT be the same.



### APEING AROUND (2011:2)

Gorillas show an inherited recessive condition called albinism. This results in white fur.

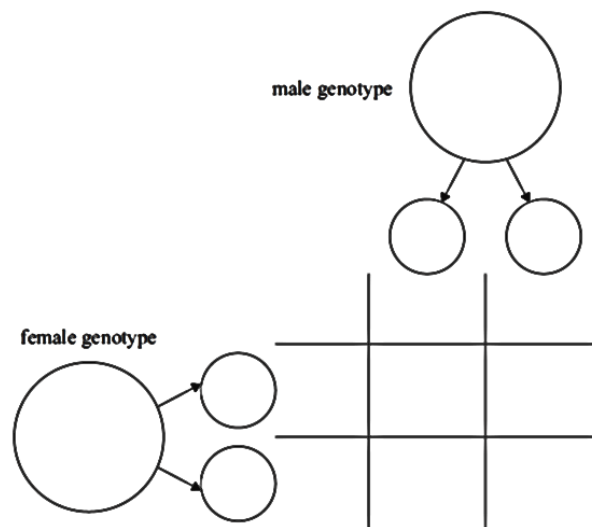
The pedigree chart below shows the inheritance of albinism in a family of gorillas. Normal fur is the dominant allele (N), while albino fur is recessive (n).



(a) Explain how the pedigree chart can be used to show that albinism is a recessive trait.

In your answer you should:

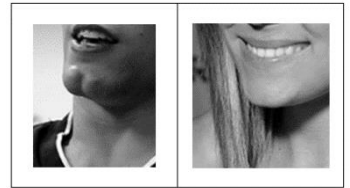
- define the terms dominant and recessive
- state the genotypes of albino and normal gorillas
- complete a labelled Punnett square to support your answer
- explain how your Punnett square shows that albinism is a recessive trait.



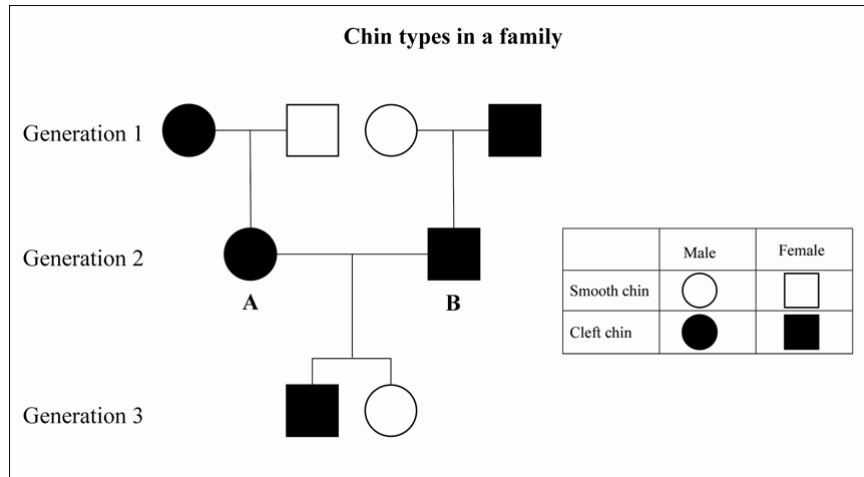
(b) Explain why the genotype of the 3 normal fur offspring in Generation IV cannot be determined, based on the evidence in the pedigree chart and your Punnett square from part (a).

## MONOHYBRID CROSSES (SAMPLE 2011:3)

The allele for a cleft chin (D) is dominant over the allele for a smooth chin (d).



The pedigree diagram shows the chin types in a family.



- (a) Explain how evidence in the pedigree diagram on page 6 shows that the cleft chin allele (D) is dominant over the smooth chin allele (d).

In your answer, you should:

- explain what the term dominant allele means
- draw a Punnett square(s) to show your reasoning.

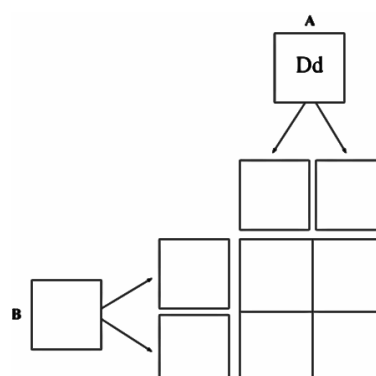
- (b) Explain why the genotype of male A in generation 2 of the pedigree diagram shown must have the genotype Dd.

- (c) Individuals A and B, as shown on the pedigree diagram on page 6, decide to have another child. They draw a Punnett square to find what type of chin their child might have.

Explain why the result predicted by the Punnett square may not accurately tell them what type of chin their child will have.

In your answer, you should:

- draw a Punnett square to show the cross between individual A and individual B
- determine the probabilities of the child having a cleft chin and having a smooth chin
- explain why the ratio of children born into the family with cleft and smooth chins may not match the probabilities.



## **CELL DIVISION**

### **SEXUAL REPRODUCTION AND SURVIVAL (2012:3)**

Explain how sexual reproduction causes genetic variation AND how this leads to increased survival of the species.

In your answer you should consider:

- the processes of gamete formation (meiosis) and fertilisation
- how sexual reproduction leads to variation in the population
- the link between genetic variation and survival of a species.

You may use labelled diagrams with notes to support your answer.

### **SEXUAL REPRODUCTION (SAMPLE 2011: 2)**

Meiosis is a particular form of cell division that produces male and female gametes.

- (a) Describe what gametes are and explain why they are needed for sexual reproduction.
- (b) Discuss how meiosis contributes to genetic variation, and why genetic variation is important in a population. In your answer, you should:
  - describe what is meant by genetic variation
  - explain how the process of meiosis leads to genetic variation
  - explain why genetic variation is of benefit to a population.

You may draw labelled diagrams to support your answer.



## GENETIC VARIATION

### SEXUAL REPRODUCTION (2013:3)

For both plants and animals, there are advantages and disadvantages to sexual reproduction.

- (a) Identify TWO **disadvantages** of sexual reproduction in **animals** and explain why they are disadvantages.
- (b) Explain how sexual reproduction contributes to variation in a population of **animals**.  
In your answer you should refer to gametes, meiosis and fertilisation.
- (c) Discuss why variation caused by sexual reproduction in a population of plants or animals is an **advantage** in a changing environment, such as a period of drought (a period of time of very dry weather, when there is no or very little rain).

Support your answers with examples.

### THE TASMANIAN DEVIL (2013:4)

Read the information to help you answer the questions.

The Tasmanian devil is known for its aggressive behaviour.  
Aggressive behaviour is **inherited** in Tasmanian devils.

The aggressive behaviour means that they fight and bite each other leading to injury and possible death. This behaviour has caused Tasmanian devils to become endangered (in danger of dying out).

- (a) Variation in phenotype can assist survival. Explain how variation in phenotype may assist the Tasmanian devil to survive in the wild and therefore avoid the species completely dying out (becoming extinct).

In your answer you should:

- define phenotype
- explain how difference in phenotype can aid survival of an individual
- explain why the LESS aggressive phenotype (Tasmanian devils that do not fight and bite) may have a survival advantage for the species.

- (b) Explain how the survival of certain individuals in the wild within the Tasmanian devil population can change the ratio of aggressive to less aggressive types of Tasmanian devil within the species over time AND relate this to the species avoiding extinction.



### GENETIC VARIATION (2012:4)



Light coloured tree



Dark coloured tree

A species of moth has two phenotypes, light and dark. Both light and dark moths are eaten by birds.

Explain how the two phenotypes of the species of moth help the population to survive if the environment changes and all the trees on which the moths live become darker.

In your answer you should:

- define phenotype
- explain how colour helps individual moths to survive
- explain why the environmental change to darker trees, affects the ratio of the phenotypes in the moth population over time.

### VARIATION (2011:4)

Genetic variation is important in a population.

- (a) Describe what is meant by the term genetic variation, and explain its importance to a population.
- (b) One process that produces genetic variation is mutation.

Explain what mutations are and how they contribute to genetic variation.

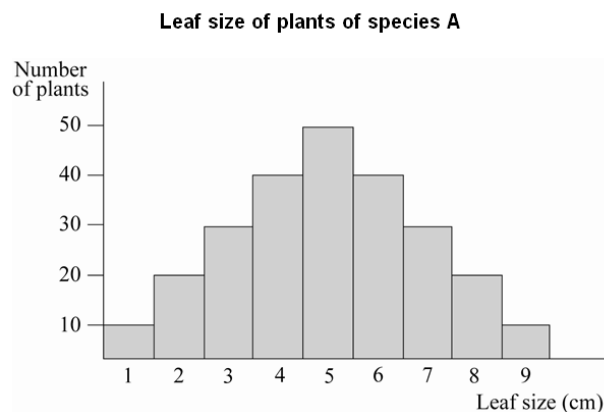
In your answer you should include:

- what a mutation is
- the effect of mutations on genes, alleles and DNA
- whether all mutations are passed on to the next generation.

### **SURVIVAL (SAMPLE 2011:4)**

Mutations can occur in DNA during cell division.

- (a) Explain whether a mutation could be inherited if it occurred in a skin cell of an individual. In your answer, you should:
- describe what a mutation is
  - explain what determines whether a mutation is able to be inherited or not.
- (b) A population of plants, species A, living in a certain area shows a lot of variation in its leaf size, from very small to very large as shown in the graph.



Leaf size affects the ability of a plant to absorb sunlight and make food. Plants with larger leaves can live in areas with lower light levels.

A new plant, species B, starts growing in the same area as species A. Species B plants grow taller than species A plants, which reduces the light available to plants growing below species B.

Discuss how variation in leaf size occurs in the starting population of species A and explain how this might help species A to survive when species B starts growing in the same area.

In your answer, you should consider:

- what causes variation within a population
- the effect of reduced light on different individuals of plant species A.