Science 1.9 AS 90948

Demonstrate understanding of biological ideas relating to genetic variation

WORKBOOK

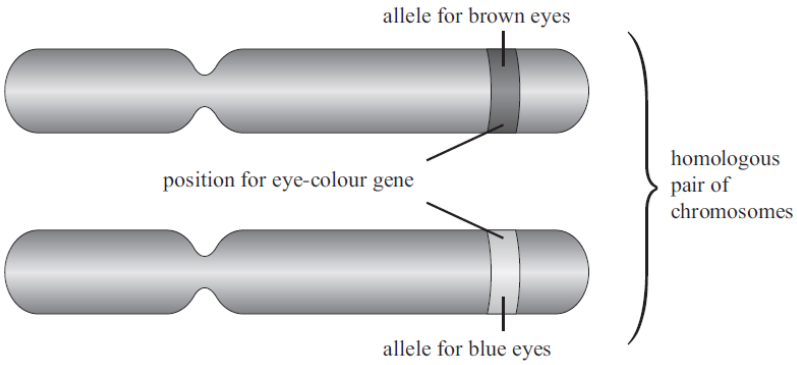
Working to Excellence & NCEA Questions

CONTENTS

All NCEA answers can be found on S1.9 ppt

Writing Excellence answers to DNA and Genes questions

DNA and Genes QUESTION
Question: Use the diagram below to help you explain the relationship between chromosomes, genes, alleles, phenotype, genotype, and the molecule DNA.



ANSWER	
1. explain link between chromosomes and DNA	
2. describe the physical structure of DNA	
3. **Explain the pairing rule of DNA**	
4. link the **base sequence to trait and gene (use example)**	
5. Give the definition for an allele (use example)	
6. link pair of chromosomes to pair of alleles	
7. link alleles to base sequence	
8. give the definition of a genotype	
9. link genotype to phenotype	
10. give definition of dominant alleles	
11. give definition of recessive alleles	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Writing Excellence answers to Genotype and Phenotype questions

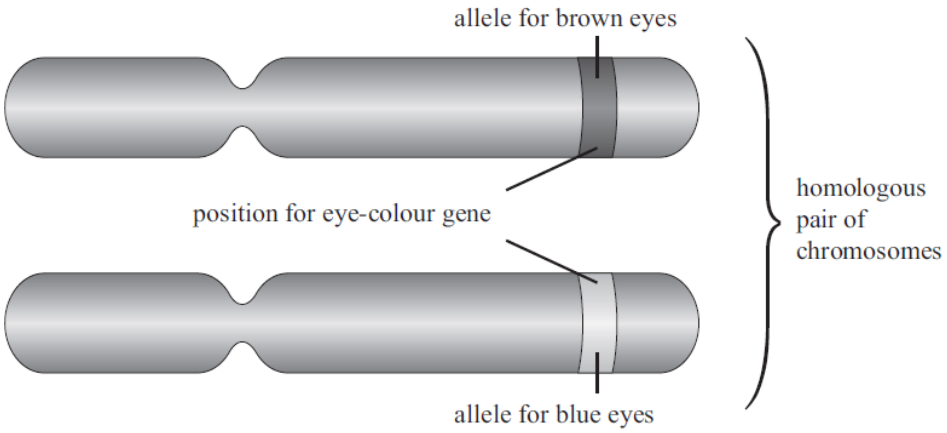
Genotype and Phenotype QUESTION	
Question: In rock pocket mice, dark fur colour (D) is dominant to light fur colour (d). Each mouse has two alleles for fur colour. Explain how they inherit these two alleles, and explain how the two alleles interact to produce different phenotypes. In your answer you should: •define phenotype and genotype •explain how the alleles are inherited from the parents •state the three possible fur colour genotypes for rock pocket mice.	

	ANSWER
1. define **genotype**	
2. define **phenotype**	
3. Explain where an individual gets a copy of each **gene**	
4. link **fertilisation** to the **gametes** involved and parents.	
5. give the definition of **dominant** alleles	
6. give the definition of **recessive** alleles	
7. define **homozygous dominant genotype** (use example above)	
8. define **heterozygous genotype** (use example above)	
9. define **homozygous recessive genotype** (use example above)	
10. link homozygous recessive **genotype to phenotype**	
11. draw a **Punnett square** showing how 2 dark coloured mice could produce both light(dd) and dark mice(DD or Dd)	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

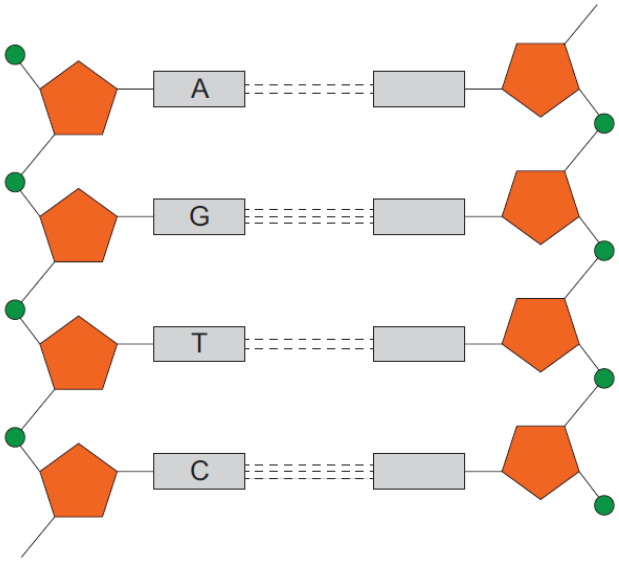
Past NCEA questions DNA, Genes and Alleles (Part ONE)

2013: 2a: Use the diagram below to help you explain the relationship between chromosomes, genes, alleles, phenotype, genotype, and the molecule DNA.



2013: 2b: 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.

2014: 1a: Label the unlabelled bases A, G, C, or T in the diagram of DNA shown below.



2014: 2d (ii) : Two brothers, who have the same parents and are not identical twins, will have different genotypes and phenotypes. Define the term genotype. Define the term phenotype.

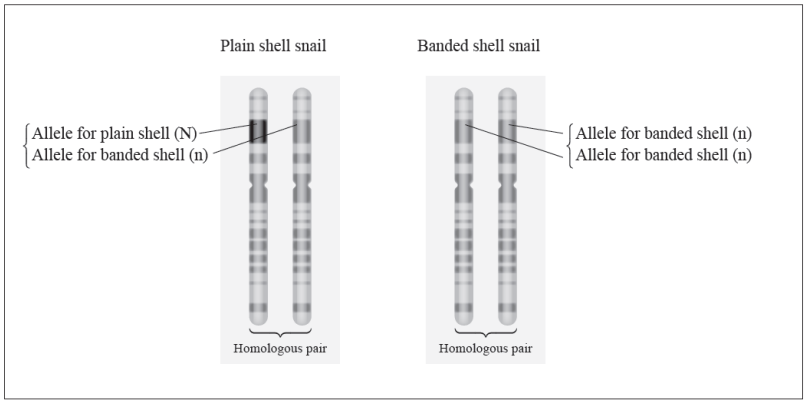
2014: 2d(iii): Explain how the two brothers with the same parents can have different genotypes.
In your answer you should explain:
• the importance of meiosis
• the role of fertilisation.

Past NCEA questions DNA, Genes and Alleles (Part TWO)

2015: A snail known as *Cepaea nemoralis* can have either a plain shell or a banded shell.

The diagrams below show the homologous chromosomes that contain the gene for shell pattern for each of the snails in the photographs above.

Assume the allele for plain shell (N) is dominant over the allele for banded shell (n).



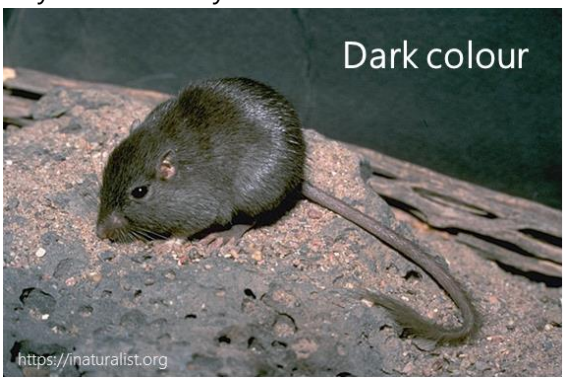
2a: Which snail is heterozygous for shell pattern?

Explain why you chose this snail.

2b: Referring to the examples shown previously for shell pattern, explain the difference between an allele and a gene.

2015: 2c: These two snails were produced by sexual reproduction from the same male and female. Discuss how they have inherited different alleles for shell pattern.
In your answer you should:
• explain where the homologous chromosomes have come from
• give the possible genotypes of both parents and explain how you determined these possible genotypes

2016: 2a: Rock pocket mice can have dark fur or light fur, as shown below.
Using the example of rock pocket mouse fur colour, explain how information carried on the DNA controls the appearance.
In your answer you should refer to DNA base sequence, genes and alleles.



Past NCEA questions DNA, Genes and Alleles (Part THREE)

2016: 2b: In rock pocket mice, dark fur colour (D) is dominant to light fur colour (d). Each mouse has two alleles for fur colour.
Explain how they inherit these two alleles and explain how the two alleles interact to produce different phenotypes. In your answer you should:
•define phenotype and genotype
•explain how the alleles are inherited from the parents
•state the three possible fur colour genotypes for rock pocket mice.

2018: 1a: The allele for rose comb (R) is dominant to the allele for single comb (r) in chickens. (a) Two rose comb chickens produce a single comb offspring.

Rose comb on a chicken

Single comb on a chicken

Explain how it is possible for two rose comb chickens to produce a single comb offspring. In your answer you should:
• define dominant allele
• explain the genotypes of the parents and offspring
• use a Punnett square to help your explanation.

2018: 1b: Explain how a breeder could use crosses to find out if a rose comb chicken has a pure breeding genotype for the trait.

In your answer:
• define pure breeding and genotype
• use Punnett squares to help you explain
• explain when the breeder could be confident of the chicken's genotype.

Writing Excellence answers to Inheritance Predictions questions

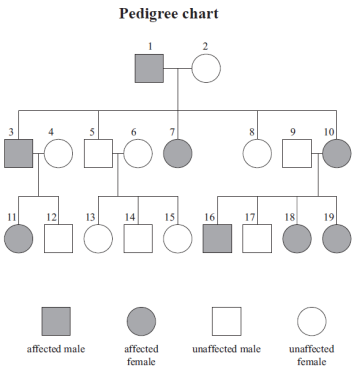
Inheritance predictions QUESTION

Question: Huntington's disease is a genetic disorder in humans. It is caused by a dominant allele (H). The normal allele is recessive (h).
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 in the Punnett square
Give reasons why the predicted ratio in the Punnett square and the observed ratio in the children may NOT be the same.

	parent 10	
	H	h
parent 9 h	Hh	hh
h	Hh	hh

Fraction of children with Huntington's disease is 1/2
Fraction of children without Huntington's disease is 1/2
Phenotype ratio is 1:1.

ANSWER

1. describe the purpose of **Punnett squares**	
2. describe the purpose of a **pedigree chart.**	
3. explain fertilisation as a **random** event	
4. link **phenotype of offspring to allele they have inherited** (use example from question)	
5. give phenotypes of offspring in **pedigree chart** and number of each	
6. compare to phenotypes predicted in **Punnett square** and number of each	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Writing Excellence answers to Test Cross questions

Test Cross QUESTION	
Question: Discuss how a farmer could develop a group of sheep that are pure breeding for white wool. Use **R** to represent the dominant allele for common white wool, and **r** to represent the recessive allele for black wool. In your answer you should: • state the genotypes of the male and female sheep the farmer should use to breed from • explain how the animal breeder can determine the genotypes of the male and female to produce sheep that all have white wool. You should include at least two Punnett squares with your explanation • explain how the animal breeder could make sure that the offspring would always be pure breeding.	
ANSWER	
1. Explain the **genotype** of the parents needed to produce a pure breeding white group	
2. describe how a **test cross** could be used to find out a sheep genotype (RR or Rr) Draw **2 Punnett Squares**	
3. explain the results of the test cross if the sheep was **RR** (Homozygous dominant) or pure breeding – link to Punnett Square	
4. explain the results of the test cross if the sheep was **Rr** (Heterozygous)or not pure breeding – link to Punnett Square	
5. explain the need for **many crosses** and link to chance	
6. explain the **requirements** for a pure breeding white flock of sheep	
7. discuss how a farmer could **continue to develop** a pure breeding white flock of sheep	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Past NCEA questions Inheritance (Part ONE)

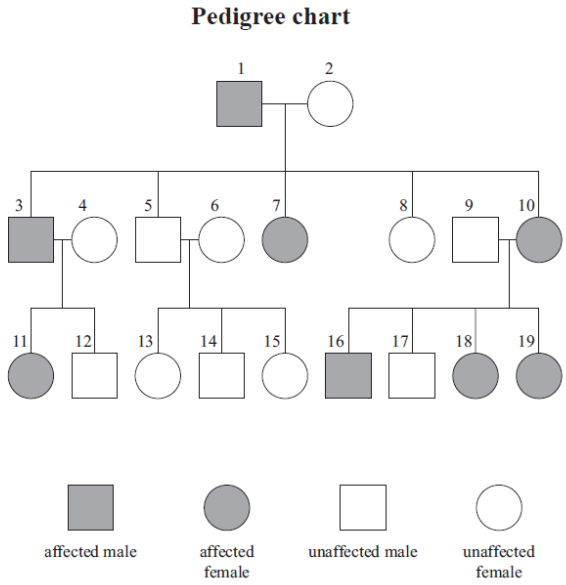
2013: 1a: Huntington's disease is a genetic disorder in humans. It is caused by a dominant allele (H). The normal allele is recessive (h).

(a) Using H and h, give the two possible genotypes for an individual who has Huntington's disease:

1b (i): State the genotype of individual 9 in the pedigree chart beside.

1b (ii): State the genotype of individual 10 in the pedigree chart beside.

1b (iii): 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.



1c: Draw a Punnett square to show the possible genotypes of the children from parents 9 and 10. From your Punnett square, predict what fraction of the children would have Huntington's disease and what fraction would not have Huntington's disease.

1d: 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 in the Punnett square

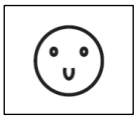
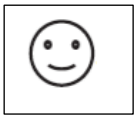
Give reasons why the predicted ratio in the Punnett square and the observed ratio in the children may NOT be the same.

2014: 3a: An animal breeder wanted to produce sheep with white wool, but some white sheep produce lambs that have black wool.
Animal breeders often use one male sheep to mate with all their female sheep.
Give all possible genotypes for each phenotype.
Use A to represent the dominant allele for common white wool, and a to represent the recessive allele for black wool.

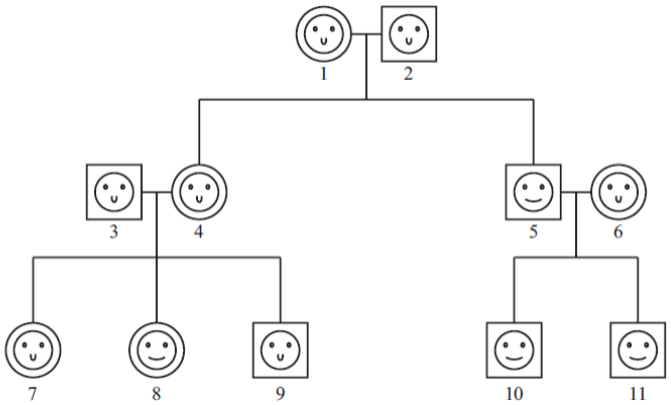
3b: Discuss how a farmer could develop a group of sheep that are pure breeding for white wool.

In your answer you should:
• state the genotypes of the male and female sheep the farmer should use to breed from
• explain how the animal breeder can determine the genotypes of the male and female to produce sheep that all have white wool.
You should include at least two Punnett squares with your explanation
• explain how the animal breeder could make sure that the offspring would always be pure breeding.

Past NCEA questions Inheritance (Part TWO)

2014: 4a: In the family tree below, people who are tongue rollers are shown as:  while those who cannot roll their tongue are shown as: 

Use the letters T and t to represent the alleles for tongue rolling (T) and non-rolling (t).



(a) (i) Use the family tree above to work out the genotype of individual 5.

(ii) Explain how you worked this out.

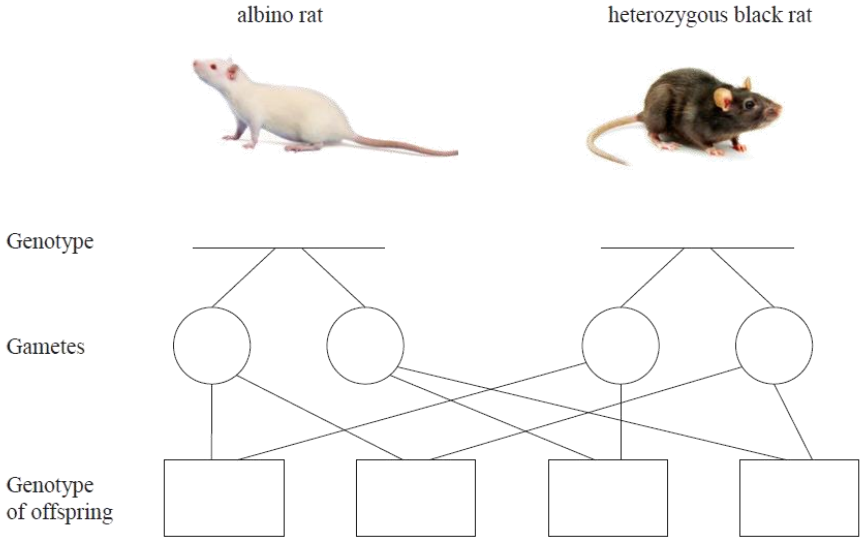
4b: Use the family tree to explain why individual 6 must be Tt.

4c: Explain why the genotypes for individuals 3 and 4 both must be Tt.

In your answer you should:
- draw Punnett squares in the box below
- explain why the genotypes of individuals 3 and 4 cannot be TT or tt.

2015: 1a: Albinism in rats results in white fur and pink eyes. Albinism is caused by a recessive allele a.

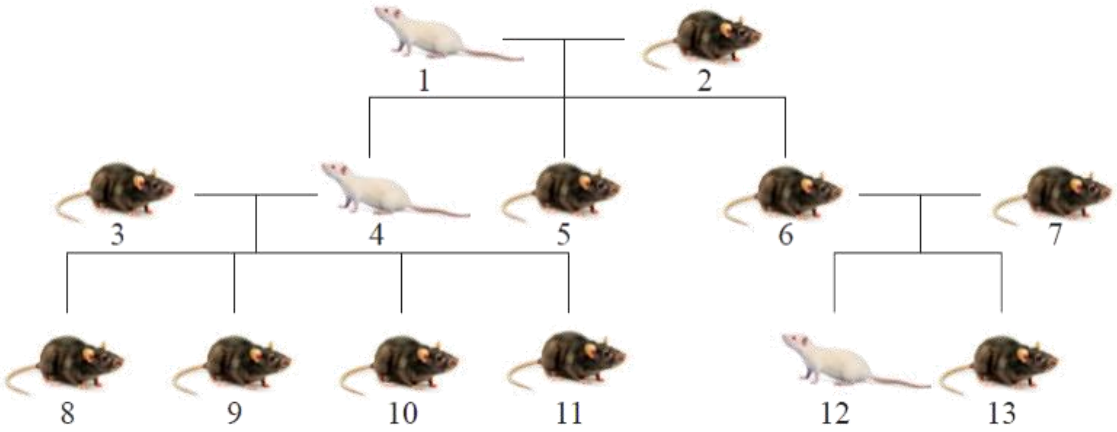
Complete the following diagram:



Sources: www.janvier-labs.com/rodent-research-models-services/research-models/per-species/outbred-rats/product/sprague-dawley.html
www.nobuggy.com/pest-wiki/rats

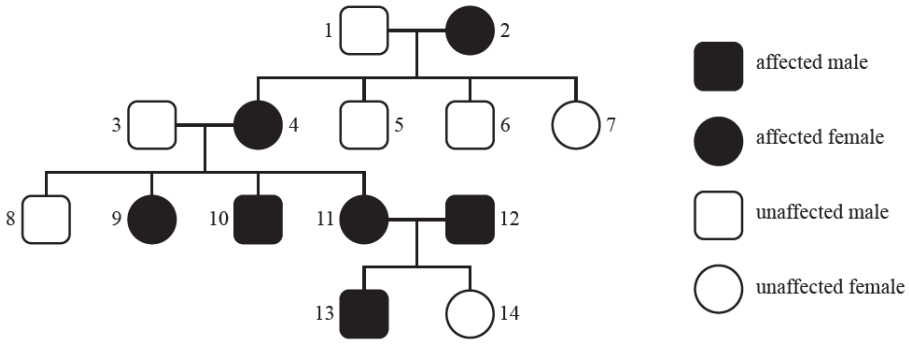
Past NCEA questions Inheritance (Part THREE)

2015: 1b: The albino rat (1) and the heterozygous black rat(2) produced the following two generations of offspring, as shown in the pedigree chart below.
What are the genotypes of the following rats? Rat 4, Rat 6, Rat 10



1c: Rat 3 was not an offspring of Rat 1 and Rat 2 in the family tree.
Give the possible genotypes for Rat 3 and explain which is the most likely genotype for Rat 3.
In your answer you should:
• state the possible genotypes for Rat 3
• explain why both genotypes are possible but one is more likely
• explain what you could do to be more certain about the genotype of Rat 3.

2016: Photic sneezing is a condition which causes affected people to sneeze due to bright light. It can be traced through a family, as shown in the pedigree chart. Photic sneezing (A) is dominant to unaffected (a).



1a: Work out the genotypes of the following four individuals: 1,2,11,12
1b: Explain how the pedigree chart can be used to show that Photic sneezing is dominant, but it cannot be used to determine the genotype of individual 13. You may use the Punnett square.
1c: The cross between 1 and 2 in the pedigree chart has one affected sneezing offspring.
The cross between 3 and 4 in the pedigree chart has three affected sneezing offspring.
Explain the difference in the number of affected offspring (photic sneezers) in these 2 crosses.
In your answer you should:
• complete Punnett squares
• give the expected phenotype ratio for each cross
• account for any difference between the expected ratio and the actual phenotype ratio for each of the crosses.

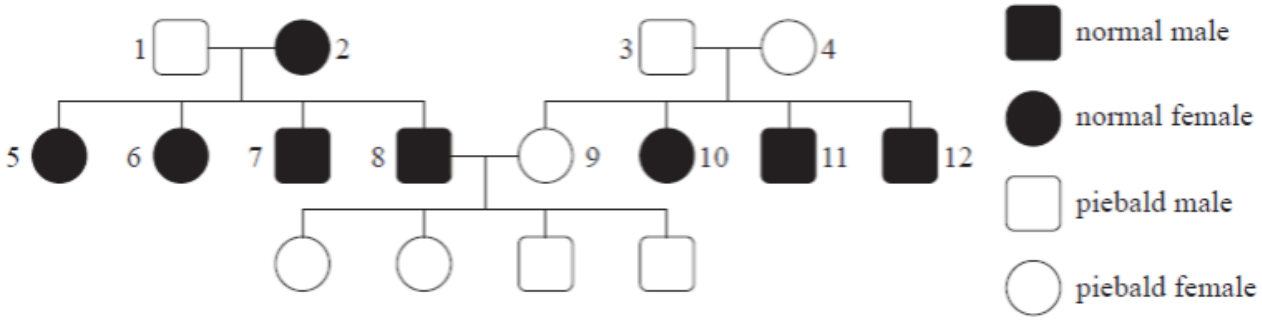
Past NCEA questions Inheritance (Part FOUR)

2017: Piebaldism is a genetic condition causing a white patch on the head and body of horses. In horses piebaldism is a dominant trait (H), and "normal" colour is recessive (h).

https://www.pinterest.nz/pin/255297872600783620/

http://www.mybligr.com/beautiful-photographs-black-horse-20-pics/beautiful-black-horse-images-pictures-photos-13/

2a: From the pedigree chart below, list all the possible phenotypes and genotypes of horses 3, 8, and 9. Use the letter H for the dominant trait and h for the recessive.



individual	Phenotype (normal or piebald)	Genotype (HH,Hh, or hh)
3		
8		
9		

2b: A breeder wants to produce only dominant (piebald) offspring from a breeding pair of horses. The breeder has piebald and normal horses to breed from.

How could the breeder use crosses to make sure that the pair of horses were pure breeding? *Show crosses using Punnett squares to support your answer.*

Writing Excellence answers to Sexual Reproduction questions

Sexual reproduction QUESTION
Question: 3a: Wild bananas have large seeds and reproduce sexually. Farmed bananas are produced asexually, from suckers called "banana pups". How does the production of **gametes** result in variation for the wild banana plants?

Wild bananas, showing seeds.

A "banana pup" growing.

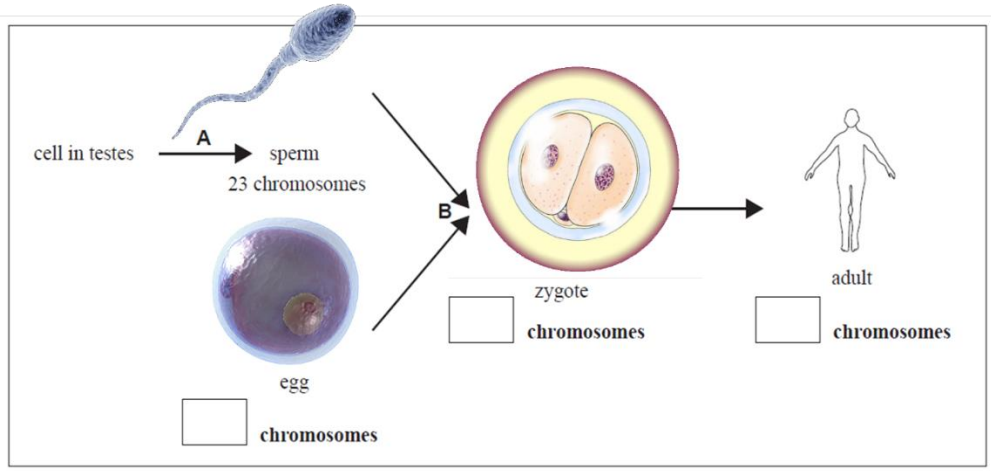
ANSWER	
1. define the term **gamete**	
2. Define Variation	
3. define sexual reproduction and link to gamete formation	
4. explain the process of fertilisation and link to chromosome number	
5. link the variation of individuals to the process of meiosis	
6. Use the example from the question to illustrate variation in traits	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Past NCEA questions Sexual Reproduction

2013: For both plants and animals, there are advantages and disadvantages to sexual reproduction.
2b: Identify TWO disadvantages of sexual reproduction in animals and explain why they are disadvantages.
3b: Explain how sexual reproduction contributes to variation in a population of animals. In your answer you should refer to gametes, meiosis and fertilisation.

2014: The diagram below shows the relationship between gametes (sex cells), zygotes, and chromosome number in humans.
2a: Name the processes represented by A and B:
2b: Complete the diagram above by writing the numbers of chromosomes in the boxes.
2c: Compare the chromosome number of the egg, sperm, zygote and adult, AND explain any differences and similarities in the numbers.



2015: 3b (i): Plants were grown from seeds. Seeds are the result of sexual reproduction.
(i) Name one process that occurs during sexual reproduction, and explain how it results in variation.
2016: 2c: Venus flytraps (*Dionaea muscipula*) are plants that live in poor quality soils. They have specially adapted leaves that snap shut to catch insects.

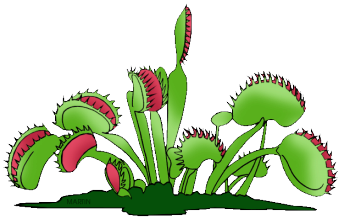
The plants reproduce sexually, involving the production of flowers.
(a) Discuss the advantages of sexual reproduction.
In your answer you should:
• define sexual reproduction
• explain how ONE important process in sexual reproduction helps to produce variation in offspring
• plant population over generations.

2017: 3a: Wild bananas have large seeds, and reproduce sexually.

Farmed bananas are produced asexually, from suckers called "banana pups".
(a) How does the production of gametes result in variation for the wild banana plants?

2018: 2b: Explain how sexual reproduction increases variation in the Italian ryegrass population. Your answer should include gamete formation and fertilisation.

Writing Excellence answers to Inheritable or Non-inheritable variation questions

inheritable or non-inheritable variation QUESTION	
Question: The Venus flytrap plants come in a number of different types, such as the "B-52" with a red leaf. A teacher brought two identical plants to class and put them in different parts of the classroom. The Venus flytrap put near a window grew short leaves and the Venus flytrap in the shade grew long leaves. Colour variation in the leaves of the Venus flytraps can be passed on to a plant's offspring, but the different leaf length cannot. **Explain why.** In your answer you should: •define inheritable and non-inheritable variation •explain what causes inheritable and non-inheritable variations.	
ANSWER	
1. define the term **inheritable variation**	
2. Explain what **effect** inheritable variation has	
3. define the term **non-inheritable variation**	
4. Explain what **effect** non-inheritable variation has	
5. link the **phenotype** related to **inherited variation** (give example from question)	
6. link the **phenotype** related to **non-inherited variation** (give example from question)	
7. complete the final statement	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Past NCEA questions Inheritable or Non-inheritable variation

2014: 1c: Variation within a species can be inheritable or non-inheritable.

Give two examples of environmental factors that can lead to non-inheritable variation in plants.

2015: The photograph to the right shows a large number of plants that are all the same species. The yellow-brown colour in some of the plants has been caused by a disease. The disease is present throughout the field, but affects only some plants. This is because of variation in the plants.

3a: Explain why variation means not all the plants get the disease.

2016: The Venus flytrap plants come in a number of different types,
such as the "B-52" with a red leaf.
A teacher brought two identical plants to class and put them in different parts of the classroom. The Venus flytrap put near a window grew short leaves and the Venus flytrap in the shade grew long leaves.

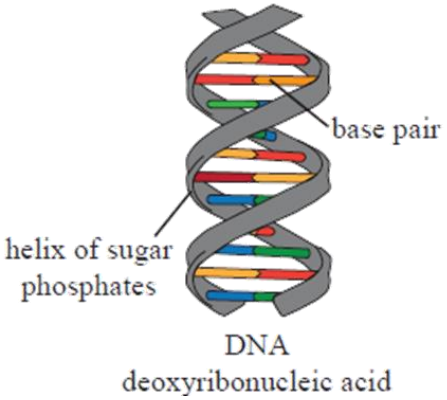
3b: Colour variation in the leaves of the Venus flytraps can be passed on to a plant's offspring, but the different leaf length cannot. Explain why. In your answer you should:
•define inheritable and non-inheritable variation
•explain what causes inheritable and non-inheritable variations.

2017: 1b: Leopards in the wild commonly have scars, especially around their faces. Explain why the leopard cubs can be born with black coats but not with scars.

2018: 3b: Explain whether the white colouration (in tūī) would be inheritable or not.

Your answer should include the terms inheritable and non-inheritable.

Writing Excellence answers to Mutation questions

Mutation QUESTION	
Question 1a: Some leopards or jaguars have a mutation causing them to have a black coat. These are known as "black panthers". (a) How can this mutation cause the coat colour to be different? In your answer you should use the terms DNA, gene, allele, phenotype, and mutation to explain how this colour change occurs. The DNA diagram below may help you.  https://pixabay.com/en/panter-leopard-black-spotted-359245/ (cc)  DNA deoxyribonucleic acid	
ANSWER	
1. define the term **DNA** linking to base codes	
2. define the term **gene** linking to trait – with example from question	
3. explain the link between mutation, change in base code and gene expression	
4. link mutation to production of new allele – with example from question	
5. link the **phenotype** related to **inherited variation** (give example from question)	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

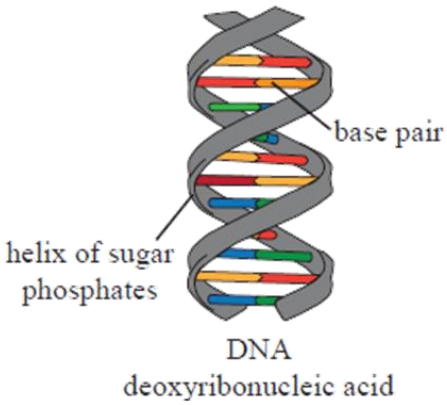
Past NCEA questions Mutation

Q: 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.

2017: 1a: Some leopards or jaguars have a mutation causing them to have a black coat. These are known as "black panthers".

(a) How can this mutation cause the coat colour to be different?
In your answer you should use the terms DNA, gene, allele, phenotype, and mutation to explain how this colour change occurs. The DNA diagram below may help you.

https://pixabay.com/en/panter-leopard-black-spotted-359245/ (cc)



DNA
deoxyribonucleic acid

2018: 3a: Leucism is a genetic condition caused by a gene mutation that results in some (or all) of an animal being white.

(a) How could a change in a gene result in the phenotype of the white tūī shown below? Your answer should include the terms DNA and allele.

http://mandyart.blogspot.com/2009/07/white-tui-albino-slug.html

A white tūī

https://www.flickr.com/photos/sidm/6557924841

A coloured tūī

Writing Excellence answers to Variation and Survival questions

Variation and Survival QUESTION	
Question: 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.	
ANSWER	
1. define **genetic variation**	
2. explain **sexual reproduction** as the process that gives individuals genetic variation	
3. **link advantage to survival** to changing environment	
4. **discuss your example** and link to how it is an advantage in a drought (or other changing environment)	
5. link survival of some to **survival of the species**	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Past NCEA questions Variation and Survival

2013: Tasmanian Devils are a species of meat-eating marsupial mammal native to Australia. They are the size of a small dog, and the males especially, are very aggressive towards each other most of the time. Aggression is a behavioural phenotype that is controlled by genes.

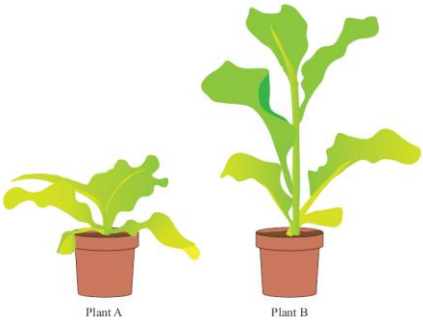
Tasmanian Devils aggression helps males fight off competitors from breeding females therefore ensuring their genes get passed to the next generation. Aggressive behaviour also ensures survival of an individual when born. A female Tasmanian Devil gives birth to 20-30 small young but only has 4 milk teats in her pouch. However, aggression costs the animal energy and risk of injury so it can also reduce the survival rate of an individual if the behaviour becomes excessive.

Variation of the aggressive behaviour trait in the population of Tasmanian Devils helps the species survive. The more aggressive Tasmanian Devils survive when there is a lack of mates or food for the females to produce milk. The more peaceful Tasmanian Devils survive when there is plenty of food and mates and they suffer less injuries, while conserving energy.

4b: 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.

2013: 3c: 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.

2014: 1c (ii) : The pictures below show two plants of the same species. Discuss how BOTH inheritable and non-inheritable factors can result in the variation of these plants, AND explain the importance of this variation within a large population of the plants growing in a changing environment.



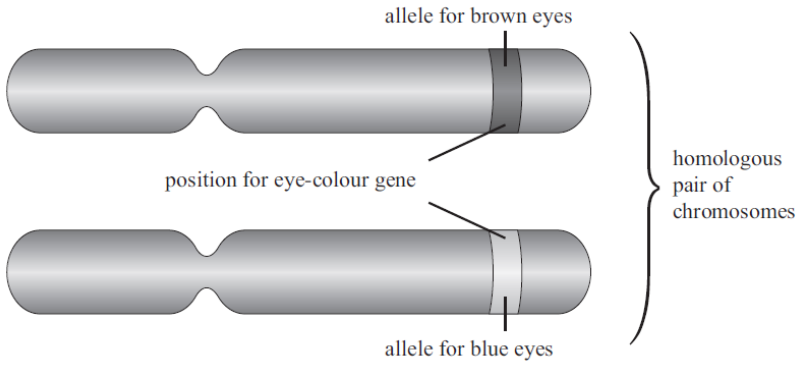
2015: 3b (ii) : Discuss the advantages of sexual reproduction for a species when the environment changes.
In your answer you should:
- give examples of a changing environment
- explain the impact of changing environments on a population
- consider the importance of variation in a population in a changing environment.

2017: 3b: Suggest a possible problem that may arise with farmed bananas (produced from suckers), and explain why this problem would not occur in wild bananas (produced sexually)?

2018: 2a: Herbicides are chemicals that are used to kill weeds. Over many years, Italian ryegrass (a common weed) has developed a resistance to some herbicides (it is no longer killed by them). (a) Explain how variation in the Italian ryegrass population can help the population develop herbicide resistance.

ANSWERS: Writing Excellence answers to DNA and Genes questions

DNA and Genes QUESTION
Question: Use the diagram below to help you explain the relationship between chromosomes, genes, alleles, phenotype, genotype, and the molecule DNA.



ANSWER	
1. explain link between chromosomes and DNA	Chromosomes are made up of DNA.
2. describe the physical structure of DNA	DNA is a large molecule that is coiled into a double helix (twisted ladder structure). It is responsible for determining the phenotype of an organism. Along this molecule are bases.
3. **Explain the pairing rule of DNA**	These bases pair up; A always pairs with T, and G with C.
4. link the **base sequence to trait and gene (use example)**	A sequence of bases which codes for a particular trait (eg, eye colour) is called a gene.
5. Give the definition for an allele (use example)	The different versions of each gene are called alleles, and these show the different variations of each characteristic, eg brown / blue eyes.
6. link pair of chromosomes to pair of alleles	Because chromosomes come in pairs for each trait, there will be two possible alleles
7. link alleles to base sequence	These different versions of genes (alleles) occur as the DNA base sequence is different.
8. give the definition of a genotype	This combination of alleles for each trait is called the genotype; this can be any combination of two of the available alleles.
9. link genotype to phenotype	The genotype determines the phenotype (the physical appearance) of the organism.
10. give definition of dominant alleles	Whichever alleles are present may be expressed. Dominant alleles (B) will be expressed over recessive alleles (b).
11. give definition of recessive alleles	Two recessive alleles are required for the recessive phenotype to be expressed

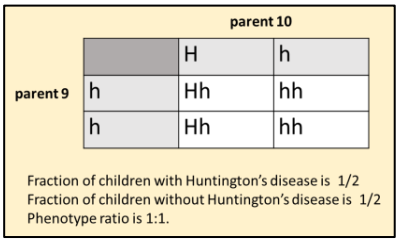
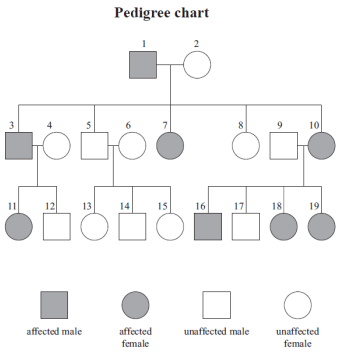
NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

ANSWERS: Writing Excellence answers to Genotype and Phenotype questions

DNA and Genes QUESTION	
Question: In rock pocket mice, dark fur colour (D) is dominant to light fur colour (d). Each mouse has two alleles for fur colour. Explain how they inherit these two alleles, and explain how the two alleles interact to produce different phenotypes. In your answer you should: •define phenotype and genotype •explain how the alleles are inherited from the parents •state the three possible fur colour genotypes for rock pocket mice.	
ANSWER	
1. define **genotype**	Genotype is the code for the alleles present for the gene.
2. define **phenotype**	Phenotype is the appearance of a trait, e.g. dark or light fur.
3. Explain where an individual gets a copy of each **gene**	Each mouse receives one copy of each gene from each of its parents during fertilisation
4. link **fertilisation** to the **gametes** involved and parents.	one gene comes from the father in the sperm and one gene comes from the mother from the egg, and so each offspring has two copies of each.
5. give the definition of **dominant** alleles	If either of these are the dominant allele the mouse will be dark, as the dark allele is dominant (and so masks the light allele).
6. give the definition of **recessive** alleles	If both of these are the recessive allele the mouse will be light
7. define **homozygous dominant genotype** (use example above)	A dark mouse can have the homozygous dominant genotype (DD)
8. define **heterozygous genotype** (use example above)	A dark mouse can also have the heterozygous genotype (Dd)
9. define **homozygous recessive genotype** (use example above)	the homozygous recessive genotype is (dd)
10. link homozygous recessive **genotype to phenotype**	A light mouse can only have the homozygous recessive genotype
11. draw a **Punnett square** showing how 2 dark coloured mice could produce both light(dd) and dark mice(DD or Dd)	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

ANSWERS: Writing Excellence answers to Inheritance predictions questions

Inheritance predictions QUESTION	
Question: Huntington's disease is a genetic disorder in humans. It is caused by a dominant allele (H). The normal allele is recessive (h). 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 in the Punnett square Give reasons why the predicted ratio in the Punnett square and the observed ratio in the children may NOT be the same.	
ANSWER	
1. describe the purpose of **Punnett squares**	Punnett squares predict probable offspring genotypes and therefore the expected phenotypes based on the alleles in the gametes of the parents.
2. describe the purpose of a **pedigree chart.**	Pedigree charts give the observed (actual) phenotypes of the offspring and parents.
3. explain fertilisation as a **random** event	Since each fertilisation is a random event, it is by 50:50 chance whether the offspring inherits which allele from both parents.
4. link **phenotype of offspring to allele they have inherited** (use example from question)	From the pedigree chart, the **offspring of number 10** that have inherited the dominant H allele has Huntington's (number 16, 18 and 19) and the offspring that have inherited the recessive h allele and does not have the disease. (number 17)
5. give phenotypes of offspring in **pedigree chart** and number of each	In the pedigree chart **3 of the 4** offspring have the disease. So 75% have inherited the H dominant allele from parent 10 
6. compare to phenotypes predicted in **Punnett square** and number of each	but only 2 out of 4 offspring would have been predicted from the Punnett square, so 50% of the offspring.

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

ANSWERS: Writing Excellence answers to Test Cross questions

Test Cross QUESTION	
Question: Discuss how a farmer could develop a group of sheep that are pure breeding for white wool. Use **R** to represent the dominant allele for common white wool, and **r** to represent the recessive allele for black wool. In your answer you should: • state the genotypes of the male and female sheep the farmer should use to breed from • explain how the animal breeder can determine the genotypes of the male and female to produce sheep that all have white wool. You should include at least two Punnett squares with your explanation • explain how the animal breeder could make sure that the offspring would always be pure breeding.	
ANSWER	
1. Explain the **genotype** of the parents needed to produce a pure breeding white group	To breed a group of white sheep, a breeder should use sheep that are both RR. Homozygous dominant
2. describe how a **test cross** could be used to find out a sheep genotype (RR or Rr) Draw **2 Punnett Squares**	The breeder can determine if a white sheep is RR by crossing a white sheep with a black sheep. The black sheep is homozygous recessive and will give 1 black allele (r) to each offspring) Possible outcomes gametes ♂ r r / ♀ R: R r R r / ♀ R: R r R r Punnett square 1 - If the phenotypes are all White wool then the unknown genotype is RR gametes ♂ r r / ♀ R: R r R r / ♀ r: r r r r Punnett square 2 - If any of the phenotypes appear as Black Wool then the unknown genotype is Rr
3. explain the results of the test cross if the sheep was **RR** (Homozygous dominant) or pure breeding – link to Punnett Square	If the white sheep is RR, none of the offspring will be black. As the sheep gave one R allele to each offspring and as this is dominant then the offspring will all be white – this can be seen in Punnett square 1
4. explain the results of the test cross if the sheep was **Rr** (Heterozygous)or not pure breeding – link to Punnett Square	If a black offspring is produced, the breeder can be certain the white parent was Rr. As black sheep are only produced when the offspring inherit a recessive (black) allele from each parent. – this can be seen in Punnett square 2
5. explain the need for **many crosses** and link to chance	The breeder would need to carry out many crosses to show that it was not just due to chance that a black sheep had not been produced, as Punnett squares are only predictions.
6. explain the **requirements** for a pure breeding white flock of sheep	The farmer should breed only with an RR male and white wool females, as this will ensure that all offspring are white.
7. discuss how a farmer could **continue to develop** a pure breeding white flock of sheep	if any black sheep appeared they should not be allowed to breed as this would remove the recessive allele from the group. Eventually the flock would become pure breeding with no r alleles present

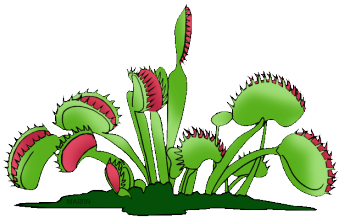
NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

ANSWERS: Writing Excellence answers to Sexual Reproduction questions

Sexual reproduction QUESTION	
Question: 3a: Wild bananas have large seeds and reproduce sexually. Farmed bananas are produced asexually, from suckers called "banana pups". How does the production of **gametes** result in variation for the wild banana plants?  Wild bananas, showing seeds.  A "banana pup" growing.	
ANSWER	
1. define the term **gamete**	A **gamete** is a sex cell with one set of chromosomes (instead of the normal 2).
2. Define Variation	**Variation** is the differences within a species.
3. define sexual reproduction and link to gamete formation	Sexual reproduction involves combining gametes from 2 parents to create a new individual. Each parent contributes a single copy of each chromosome to a gamete.
4. explain the process of fertilisation and link to chromosome number	Therefore, when these are combined (forming the zygote), the offspring has the combined information from 2 individuals
5. link the variation of individuals to the process of meiosis	As the chromosomes are shuffled randomly during meiosis every gamete is different, and so each individual (even from the same 2 parents) is a unique combination of its parent's alleles.
6. use the example from the question to illustrate variation in traits	In this way, meiosis increases variation, for example, some bananas might have more or fewer seeds, or bigger fruit, or grow taller.

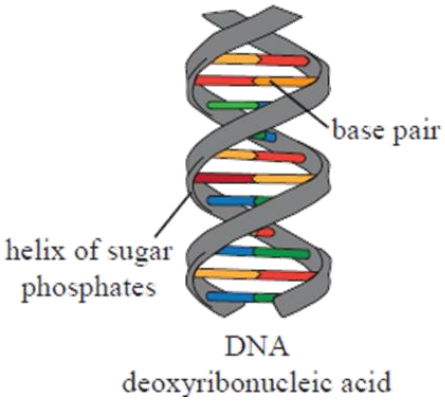
NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Writing Excellence answers to Inheritable and Non-Inheritable questions

Inheritable or Non-inheritable variation QUESTION	
Question: The Venus flytrap plants come in a number of different types, such as the "B-52" with a red leaf. A teacher brought two identical plants to class and put them in different parts of the classroom. The Venus flytrap put near a window grew short leaves and the Venus flytrap in the shade grew long leaves. Colour variation in the leaves of the Venus flytraps can be passed on to a plant's offspring, but the different leaf length cannot. **Explain why.** In your answer you should: •define inheritable and non-inheritable variation •explain what causes inheritable and non-inheritable variations.	
ANSWER	
1. define the term **inheritable variation**	Inheritable variation can be passed on to offspring and involves a change or mutation of information in the DNA (due to the base sequence)
2. Explain what **effect** inheritable variation has	The variation will be contained in the DNA of every cell in the body because it was present in the gametes (egg and sperm)
3. define the term **non-inheritable variation**	Whereas non-inheritable variation may be due to the environment (or only occurs in body cells) and is gained after fertilisation.
4. Explain what **effect** non-inheritable variation has	Non-inheritable variation affects only that organism during its lifetime, not its offspring.
5. link the **phenotype** related to **inherited variation** (give example from question)	The red colouration of the venus flytrap is due to DNA differences, and so can be passed on to its offspring– as long as the DNA in the gametes is also affected.
6. link the **phenotype** related to **non-inherited variation** (give example from question)	Lack of light has caused the fly trap in the shade to grow longer leaves. This is not due to a change in the DNA, and so cannot be passed on
7. complete the final statement	**Genetics determines the characteristics you will be born with and this is called inheritable variation, but environment then affects these characteristics once you are born and this is called non-inherited variation.**

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

ANSWERS: Writing Excellence answers to Mutation questions

Mutation QUESTION
Question 1a: Some leopards or jaguars have a mutation causing them to have a black coat. These are known as "black panthers". (a) How can this mutation cause the coat colour to be different? In your answer you should use the terms DNA, gene, allele, phenotype, and mutation to explain how this colour change occurs. The DNA diagram below may help you.  https://pixabay.com/en/panter-leopard-black-spotted-359245/ (cc)    DNA deoxyribonucleic acid

ANSWER	
1. define the term **DNA** linking to base codes	**DNA** carries genetic information as a base code.
2. define the term **gene** linking to trait – with example from question	A **gene** is a section of DNA that codes for 1 trait – in this case colouration.
3. explain the link between mutation, change in base code and gene expression	A **mutation** is a change in the DNA base code, which affects the way a gene is expressed.
4. link mutation to production of new allele – with example from question	In this case, a mutation in the colouration gene could produce a new **allele** (form of a gene) – black.
5. link the **phenotype** related to **inherited variation** (give example from question)	This is a new **phenotype** – the physical expression of the gene.

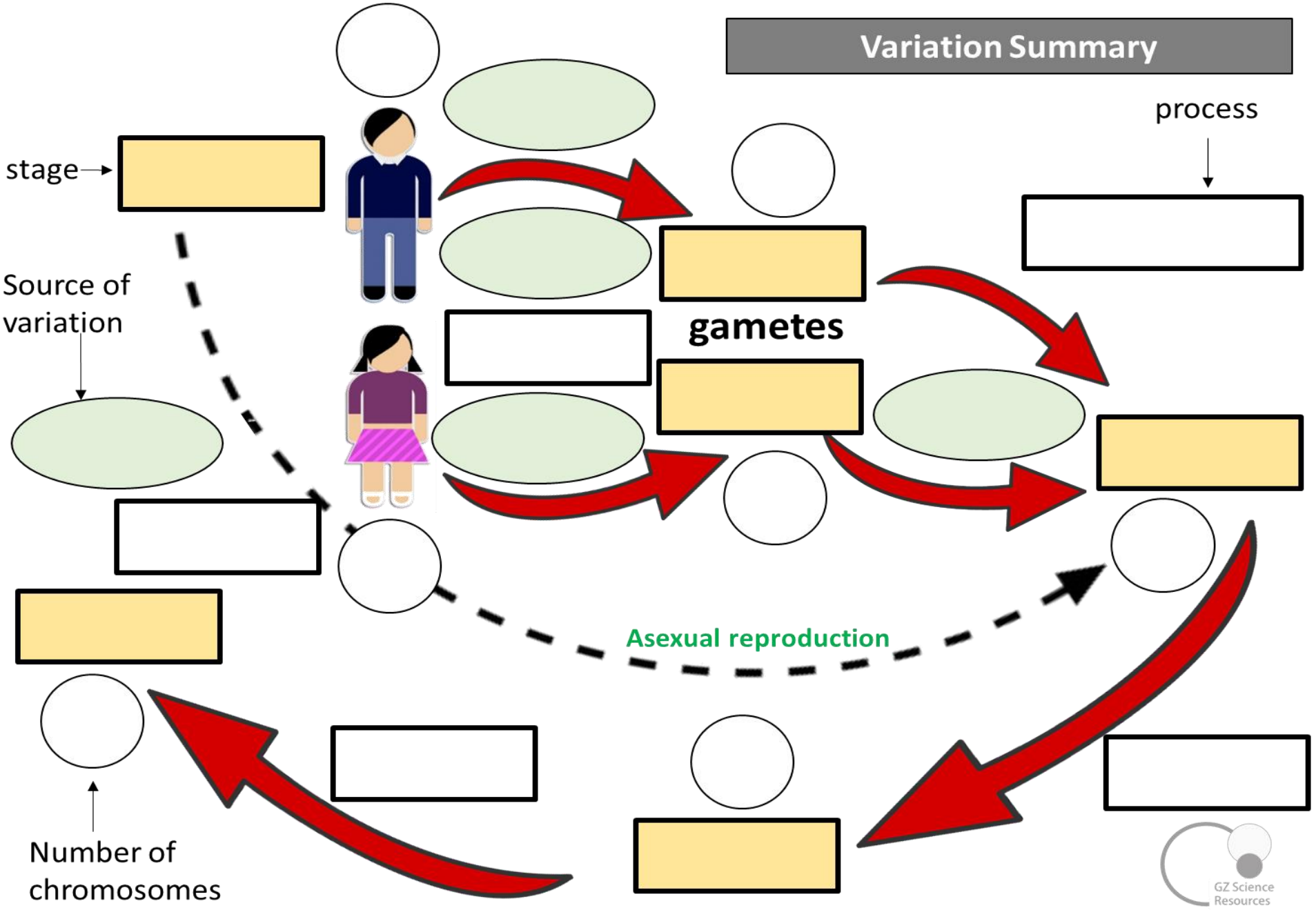
NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

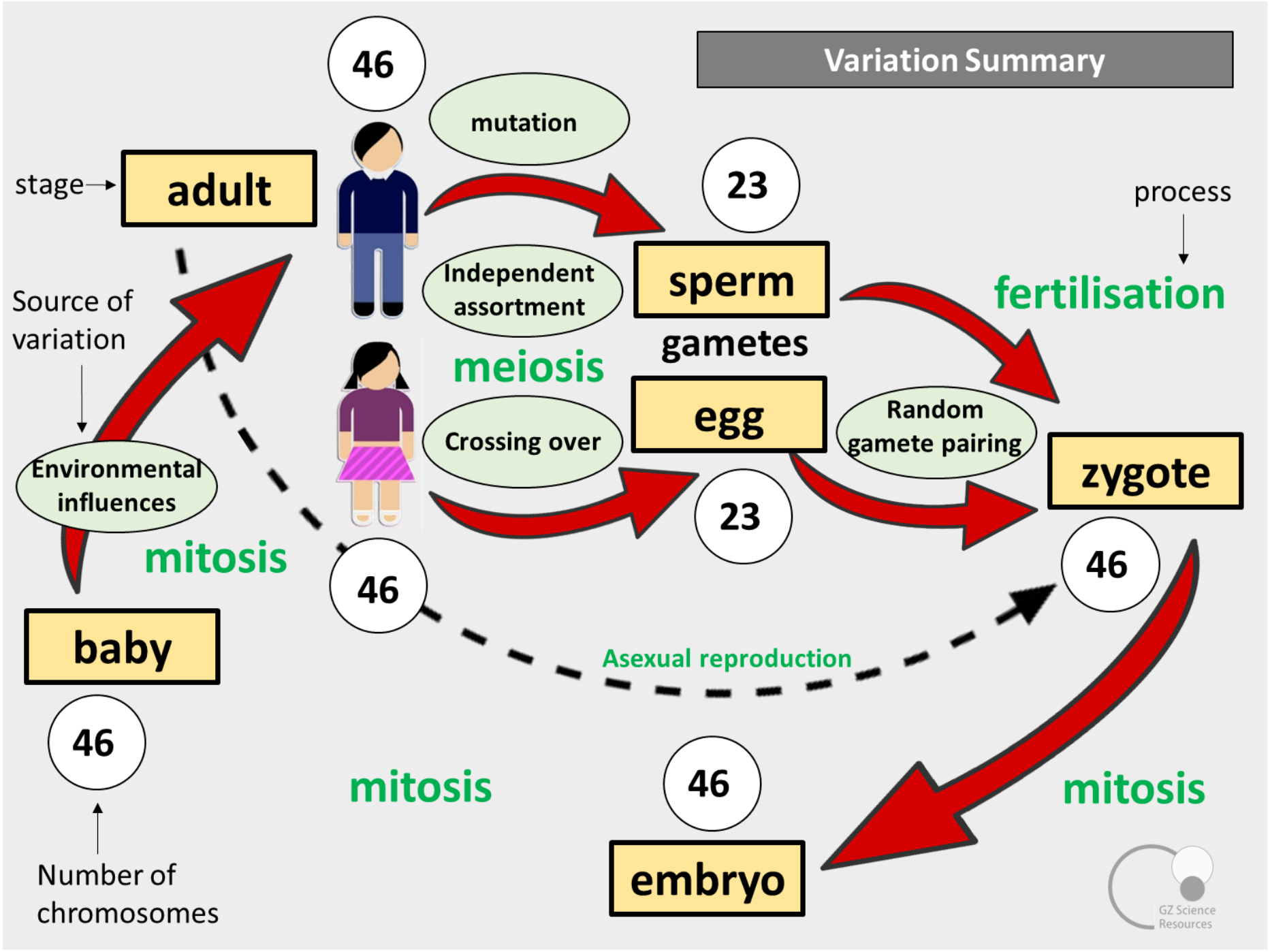
ANSWERS: Writing Excellence answers to Variation and Survival questions

Variation and Survival QUESTION
Question: 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) In your answer you should: • define sexual reproduction • explain how ONE important process in sexual reproduction helps to produce variation in offspring (Support your answers with examples)

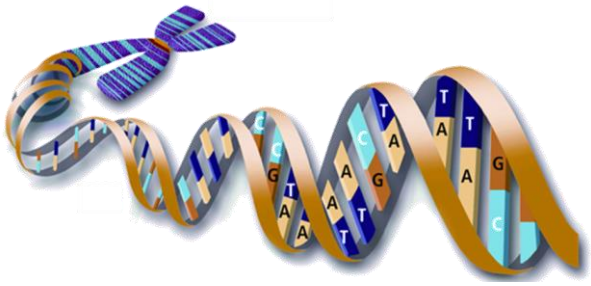
ANSWER	
1. define **genetic variation**	Genetic variation is variety within a population of their traits or phenotype. It means there are different alleles possible for each gene.
2. explain **sexual reproduction** as the process that gives individuals genetic variation	Sexual reproduction involves combining DNA from two parents using gametes. These gametes (sex cells) are formed during meiosis. Gametes have only one set of chromosomes, and so these can be combined with another parent to make a unique individual. This increases variation [OR crossing over OR independent assortment OR meiosis OR fertilisation].
3. **link advantage to survival** to changing environment	The advantage of variation to a population is that it may see some individuals survive if environment changes, in this case if drought occurs If there is variation in their alleles (DNA / genes) some individuals may have phenotypes that are more suited to the environment; therefore they will be more likely to survive.
4. **discuss your example** and link to how it is an advantage in a drought (or other changing environment)	For example: The length of a giraffe's neck, a phenotype, is controlled by genes. There is continuous variation of the neck length within a population. A longer neck will help giraffes reach leaves higher in the tree but makes it more difficult for the animal to drink and for blood to circulate to the head compared to a shorter neck giraffe. In a year where there is a drought, and a shortage of food, the giraffes with a longer neck phenotype are more able to reach higher into the trees for food than the shorter necked giraffes can. The extra food that the longer necked giraffes can eat may mean their survival and reproductive rate is higher than shorter necked giraffes and they pass their alleles onto the next generation and allow the species to survive.
5. link survival of some to **survival of the species**	Because of variation, not all individuals will be wiped out. Those with favourable alleles (traits / phenotypes) such as the long neck in giraffes, will survive and be able to pass on genetic material to offspring and therefore survival of the species occurs.

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.


Variation Summary
process
stage
Source of variation
gametes
Asexual reproduction
Number of chromosomes
GZ Science Resources


Variation Summary
46
mutation
stage
adult
23
process
Source of variation
Independent assortment
sperm
fertilisation
gametes
meiosis
egg
Random gamete pairing
Crossing over
Environmental influences
zygote
23
mitosis
46
46
baby
Asexual reproduction
46
mitosis
46
mitosis
embryo
Number of chromosomes
GZ Science Resources

Genetic Definitions



creates

gametes:

caused by

Meiosis:

Genetic variation:

which can be

continuous variation:

that join together during

fertilisation:

with genetic material held in

Chromosomes:

shown by the

phenotype:

or which can be

discontinuous variation:

shown by a

Punnett Square:

which gives a

Phenotype ratio:

a full set are seen in a

karyotype:

is determined by the

genotype:

when it creates a

zygote:

and the chromosomes are made of

DNA:

heterozygous: (Rr)

or

homozygous: (RR) or (rr)

which can be

that continues to grow by

mitosis:

lengths of which form a

gene:

a single unit of which is a

nucleotide:

also called

Pure breeding:

that create a

trait:

different varieties are called

alleles:

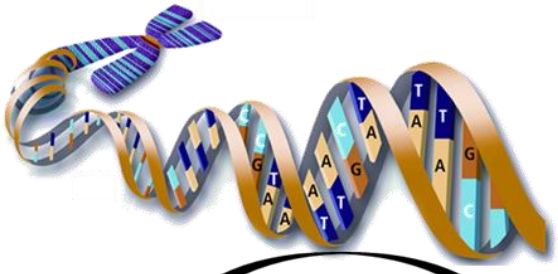
and can be

dominant:

or

recessive:

Genetic Definitions



gametes: sex cell eg sperm or egg. Only contains half the DNA (Chromosomes) of normal body cells.

creates

Meiosis: The process of cell division for the production of gametes.

caused by

Genetic variation: the range of characteristics that exist between individuals as a result of genetic differences.

which can be

continuous variation: Variation that shows a range of possible of possibilities e.g. skin colour, height and weight.

that join together during

fertilisation: when a male and female gamete fuse to form a diploid.

with genetic material held in

Chromosomes: a package of DNA containing many genes

shown by the

phenotype: the physical characteristic expressed

or which can be

discontinuous variation: Variation that is "either/or" eg blood groups or ability to roll tongue.

shown by a

Punnett Square: the grid of squares that may be drawn to show the range of combinations of genes that may occur.

which gives a

Phenotype ratio: ratio of phenotypes e.g. 3 brown hair: 1 blond hair. (a prediction of the phenotypes)

a full set are seen in a

Karyotype: A photograph or diagram of the chromosomes of a cell organised by number and size.

is determined by the

genotype: the allele combination present

when it creates a

zygote: The cell formed when a sperm cell fuses with an egg cell.

and the chromosomes are made of

DNA: Deoxyribonucleic acid – a double helix shaped molecule that carries a genetic code.

heterozygous: (Rr) 2 different alleles are present

or

which can be

homozygous: (RR) or (rr) 2 copies of the same allele are present

that continues to grow by

mitosis: cell division producing body cells for growth and repair.

lengths of which form a

gene: a section of DNA on a chromosome that codes for a particular characteristic (e.g. eye colour)

a single unit of which is a

nucleotide: consisting of a phosphate and a sugar connected to a base. The bases are A joined to T and C joined to G

also called

Pure breeding: a pure breeding individual has 2 copies of the same allele (homozygous)

that create a

trait: Another word for a characteristic, e.g. brown hair

different varieties are called

alleles: a specific version of a gene (e.g. blue eye colour)

and can be

dominant: only one dominant allele present for that characteristic to be expressed so if present then it is expressed.

or

recessive: two recessive alleles must be present for that characteristic to be expressed