

Chapter 17 - Genetic Crosses

Gametes are haploid cells that are capable of fusion.



Fertilisation is the union of two gametes to form a single cell called a zygote.



Alleles are different forms of the same gene.



We have 2 versions of most genes. These are called **alleles**.

We get one gene from each parent.

The extra gene is a back-up incase there is a mistake in one of the genes.

If both genes have a problem then the person will have a **genetic disorder**.

The **locus** of a gene is its position on a chromosome.



Dominant means that the allele prevents the working of the recessive allele.



Dominant is a gene that is **stronger** than the other gene. It is **expressed** and stops the other gene (allele) from working. The letter for the dominant gene is always a **Capital** letter.

Recessive means the allele is prevented from working by a dominant allele.



Recessive means that it is stopped from working. Only if a person has 2 recessive genes will they be allowed to work.

Genotype means the genetic make-up of an organism, i.e. the genes that are present.



The Genotype are the 2 **letters** used to represent the Genes, e.g BB

Phenotype means the physical make-up, or appearance, of an organism.



The Phenotype is what the organism **physically** looks like, e.g Black coloured coat.

Genotype + environment = phenotype



Question 1

Question 1

In cats, black coat (B) is dominant over white coat (b). Give the genotypes and phenotypes for the offspring of a cross involving two cats whose genotypes are (BB) and (bb).

Heterozygous means that the alleles are different.



Homozygous means that two alleles are the same.



Question 2

Question 2

In pea plants, green pods (G) are dominant to yellow pods (g). Show by means of diagrams the genotypes and phenotypes of the F₁ progeny that result from crossing two heterozygous plants.

Parental Phenotype											
Parental Genotype											
Gametes	<table border="1"> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>										
Offspring Genotype											
Offspring Phenotype											

Question 3

Question 3

In flies, long wing is dominant to short wing.
If a homozygous dominant fly is crossed with a homozygous recessive fly:

- (a) What letter should represent long wing?
- (b) Give the genotype of the homozygous dominant parent.

Parental Phenotype		
Parental Genotype		
Gametes		
F1 Progeny Genotype		
F1 Progeny Phenotype		

Question 4

In flies, straight wing (S) is dominant over curved wing (s). A homozygous dominant fly is crossed with a curved wing fly.

Show by diagrams the possible genotypes and phenotypes for the F₁ generation of this cross.

Parental Phenotype		
Parental Genotype		
Gametes		
F1 Generation Genotype		
F1 Generation Phenotype		

Question 5

In the fruit fly, *Drosophila*, body colour is controlled by two alleles. The allele for grey body (G) is dominant to the allele for black body (g).

If two heterozygous flies are crossed, show by diagrams that the ratio of flies with grey bodies to flies with black bodies is 3:1.

Parental Phenotype		
Parental Genotype		
Gametes	<div style="border: 2px solid black; width: 100%; height: 100%;"></div>	
F1 Generation Genotype		
F1 Progeny Phenotype		
Ratio		

Incomplete Dominance

Incomplete dominance means that neither allele is dominant or recessive with respect to the other. Both alleles work in the heterozygous genotype to produce an intermediate phenotype.



Question 6

Flower colour in snapdragons shows incomplete dominance, i.e. the heterozygous condition (Rr) is pink.

Give the phenotypes and genotypes for the progeny of the following crosses:

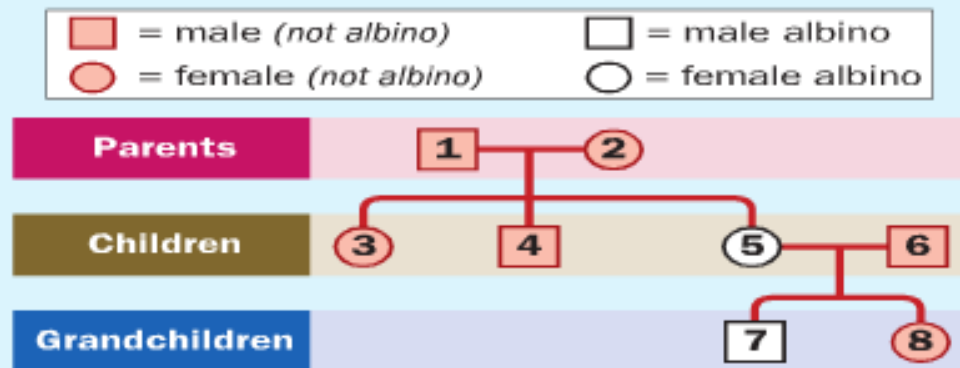
- (a) a white-flowered plant and a red-flowered plant, and
 (b) two pink-flowered plants.

Parental Phenotype		
Parental Genotype		
Gametes		
F1 Generation Genotype		
F1 Progeny Phenotype		
Ratio		

Question 7

In humans, the ability to produce the skin pigment melanin is controlled by a dominant allele (N). Lack of pigment (albinism) is controlled by the recessive allele (n).

The pedigree for a family is represented below.



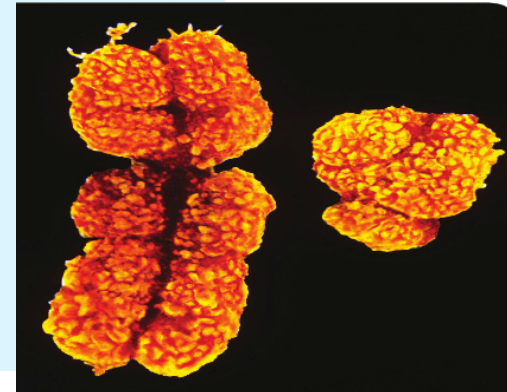
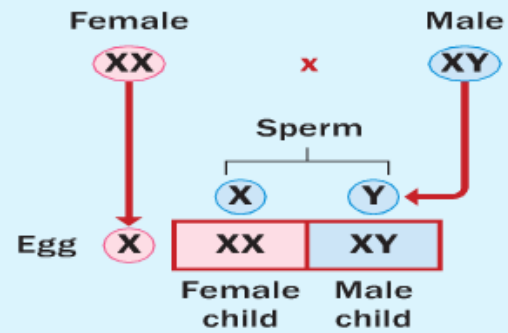
- Give the genotypes of persons 1, 2 and 5.
- Could person 6 be homozygous dominant?
Give a reason for your answer.
- How many children had the parents 1 and 2?
- Give all the possible genotypes for person 4.

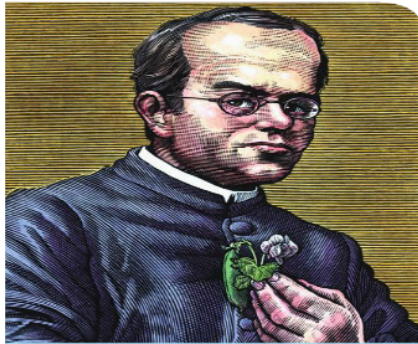
Question 8

Question 8

Show by diagrams why in humans the father determines the sex of a child.

Answer 8



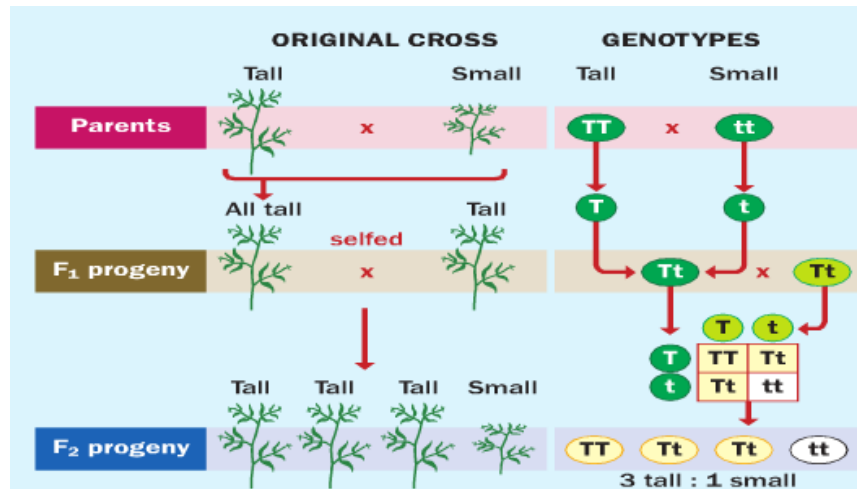


17.13 Gregor Mendel (1822–84)

Law of segregation

The **law of segregation** (Mendel's first law) states that:

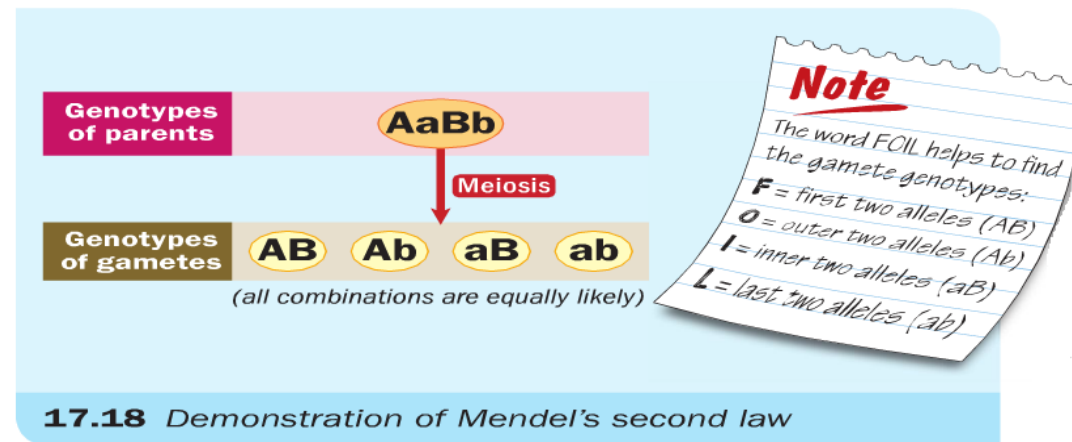
- Inherited characteristics are controlled by pairs of factors.
- These factors segregate (or separate) from each other at gamete formation, with only one member of the pair being found in each gamete.



Law of independent assortment

The **law of independent assortment** states that:

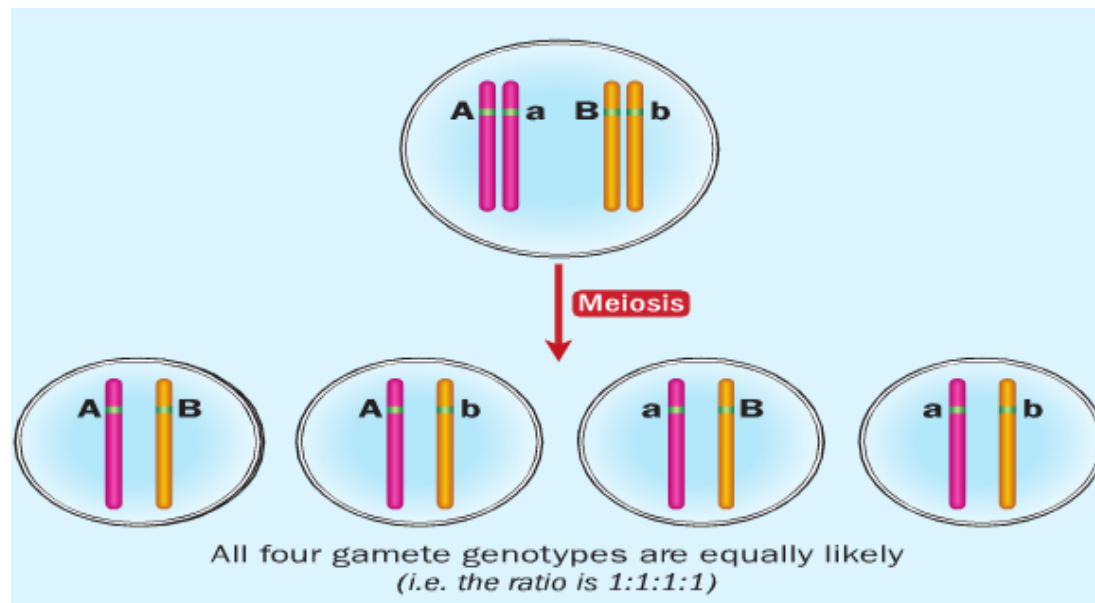
- when gametes are formed...
- either of a pair of factors...
- is equally likely...
- to combine with either of another pair of factors.



Monohybrid and Dihybrid Crosses

So far we've only looked at one characteristic or trait. This is a Monohybrid.

Dihybrid is when there are two traits at the same time.



Question 10

In guinea pigs, black coat (B) is dominant to white coat (b). Also short hair (S) is dominant to long hair (s).

- (a) Show the genotypes and phenotypes of the F₁ progeny for a cross involving a black-coated, short-haired guinea pig (heterozygous for both traits) and a white-coated, long-haired animal.
- (b) State the expected ratio of the offspring.

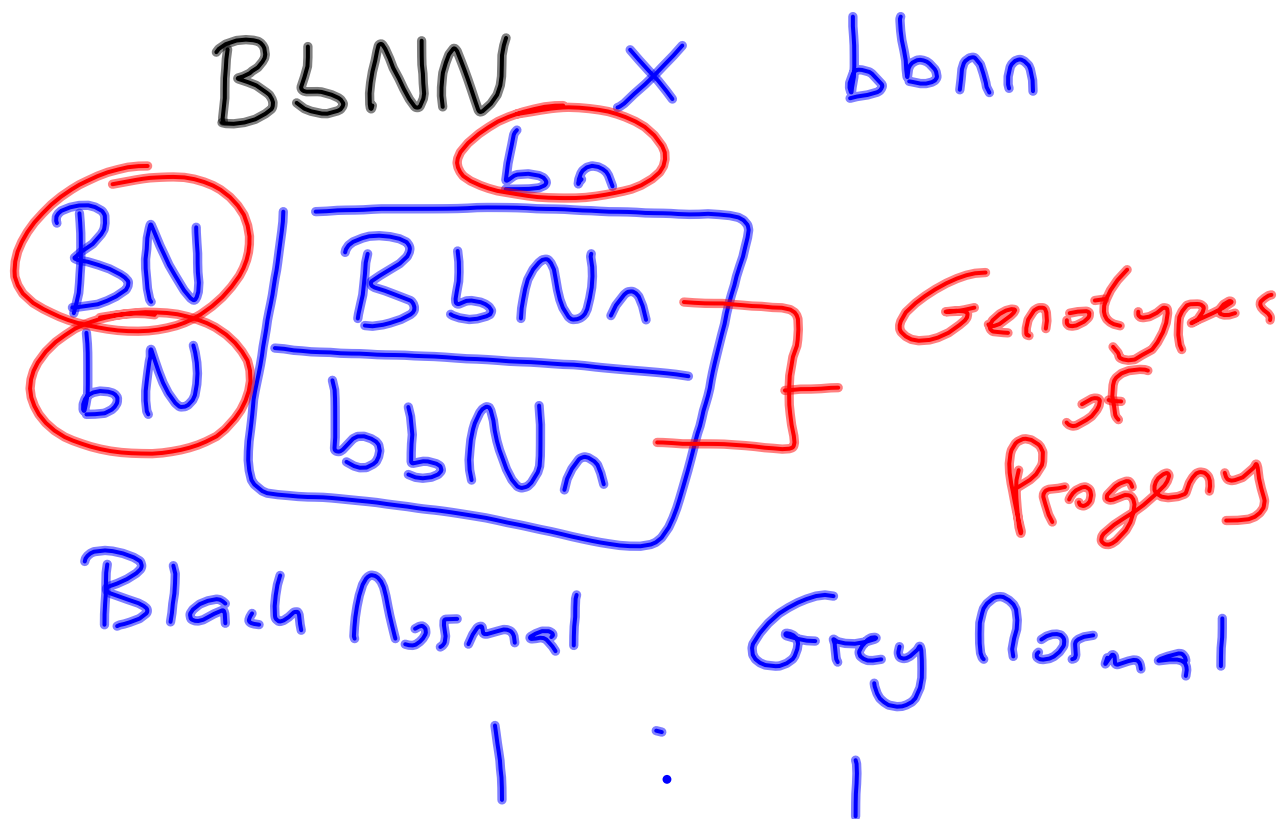
Parental Phenotype		
Parental Genotype		
Gametes		
F1 Generation Genotype		
F1 Progeny Phenotype		
Ratio		

Parental Phenotype		
Parental Genotype		
Gametes		
F1 Generation Genotype		
F1 Progeny Phenotype		
Ratio		

Question 11

Parental Phenotype		
Parental Genotype		
Gametes		
F1 Generation Genotype		
F1 Progeny Phenotype		
Ratio		

Question 12



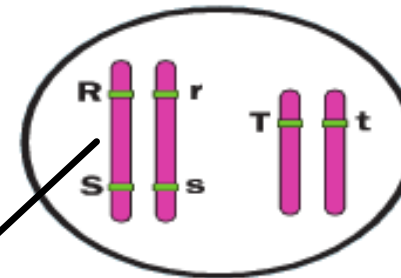
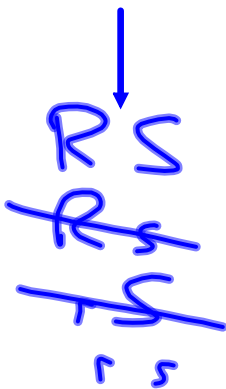
Linkage

Linkage means that genes are located on the same chromosome.



The genes R and S are linked.
The alleles T is not linked.

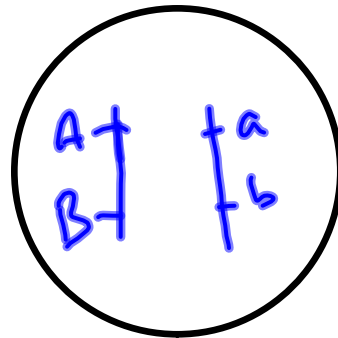
RrSs



Question 13

Draw simple chromosome diagrams to illustrate the following cells. In each case show the gametes that might be produced.

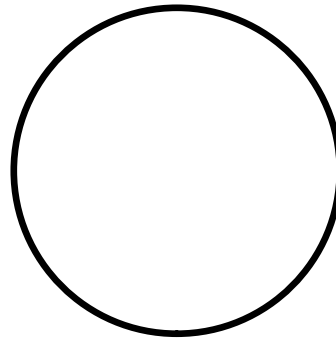
- (a) The genes are not linked and the genotype is AaBb.
- (b) The genes are linked (A to B and a to b) and the genotype is AaBb.



Question 13

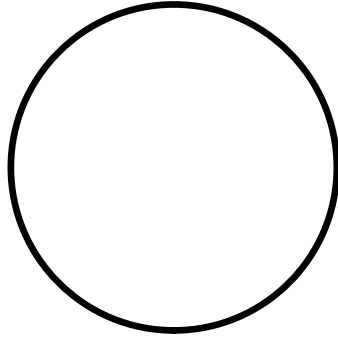
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- (a) The genes are not linked and the genotype is AaBb.
- (b) The genes are linked (A to B and a to b) and the genotype is AaBb.

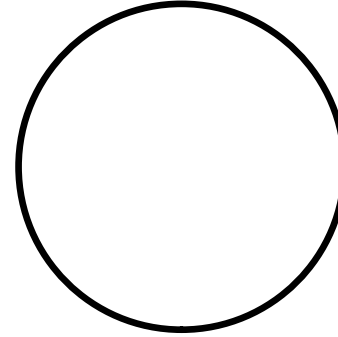


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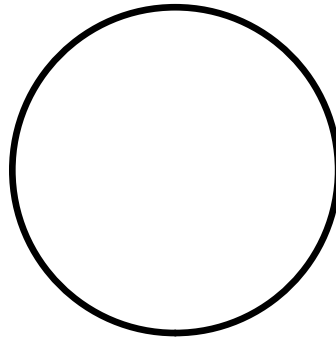
(a)



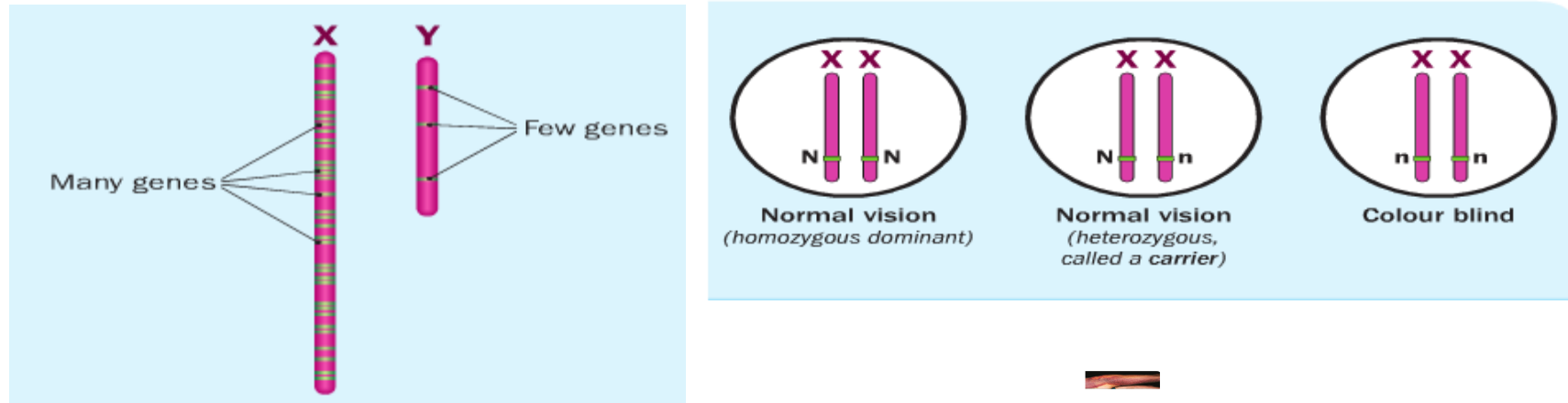
(b)



(c) Genes are not linked - hetero for A, Homo for B



Sex Linkage - means that a characteristic is controlled by a gene on an X-chromosome.



Colour blindness - is sex linked.

If the mother is colour blind then her son will be colour blind.

This is because he gets her X chromosome with the recessive gene.

He doesn't get any gene from his father on the Y chromosome.

Haemophilia is a bleeding disease where the blood doesn't clot properly.

Haemophiliacs may bleed to death from internal bleeding.

Question 16

The gene for haemophilia is located on an X chromosome. Normal blood clotting (N) is dominant over haemophilia (n).

Show the genotypes and phenotypes of the offspring of a cross between a mother who is a carrier and a father who is normal for this trait.

Parental Phenotype	Carrier ♂	Normal ♀
Parental Genotype	$X^N X^n$	$X^N Y$
Gametes	X^N X^n	X^N Y
F1 Generation Genotype	$X^N X^N$ $X^N Y$ $X^N X^n$ $X^n Y$	
F1 Progeny Phenotype	Girl normal Girl Carrier Boy Normal Boy Haemo	
Ratio		