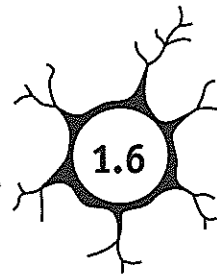
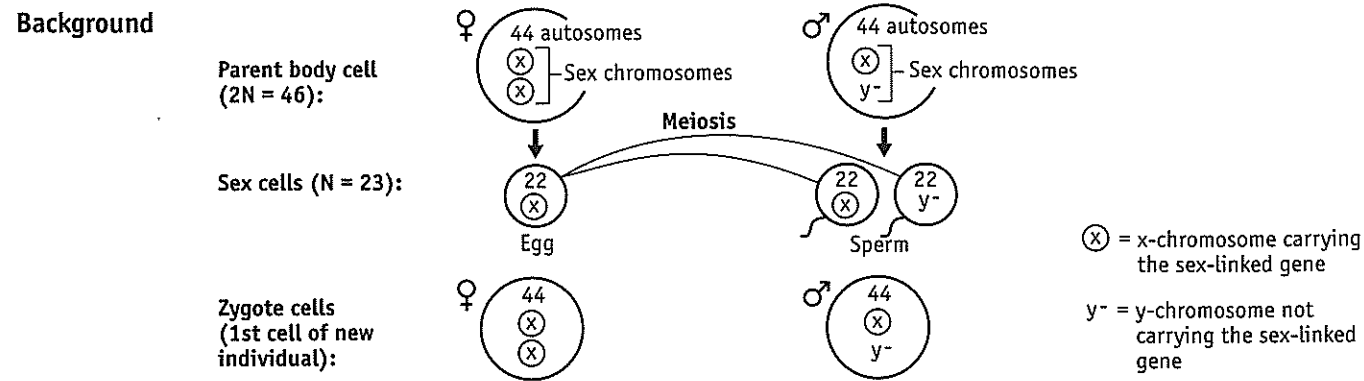


1 GENETICS

Sex-linked inheritance

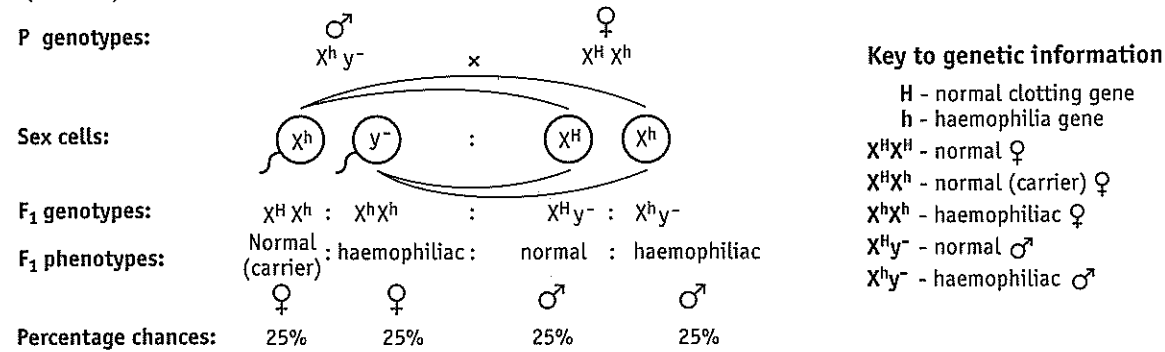


In mammals, genes for some characteristics are carried on the X-chromosome only. The Y-chromosome, while carrying some genes, is always 'blank' with respect to the gene for this particular sex-linked characteristic.



Worked example

In humans, haemophilia is a rare condition where the blood fails to clot. It is inherited as a sex-linked recessive gene — that is, the genes for the condition are carried on the X-chromosome. Consider a haemophiliac man who marries a normal (carrier) female.



1 Work out the percentage chances of the following marriages producing a haemophiliac child:

- (a) $X^H Y^- \times X^H X^H$ (c) a normal male × carrier female
(b) $X^h y^- \times X^H X^H$ (d) a haemophiliac male × carrier female

2 In humans red-green colour blindness is an inherited condition which is sex-linked and recessive.

- (a) If a colour-blind man marries a woman who is homozygous for normal vision, work out the expected phenotypes of their children.
(b) A woman with normal sight whose father is colour-blind marries a man with normal vision. What are the chances of their first child being colour-blind?

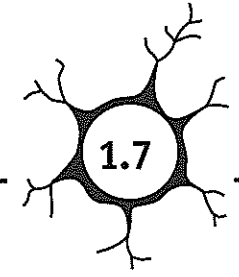
3 'X-linked mental retardation' is the most common form of mental retardation in males. The gene responsible (m) is sex-linked and recessive. If a normal male marries a heterozygous female, what would be the risk of producing an affected child?

4 In cats, black coat colour (B) is incompletely dominant over the gene for orange coat colour (b). All heterozygous cats (Bb) have a tortoiseshell coat colour. The condition is also sex-linked.

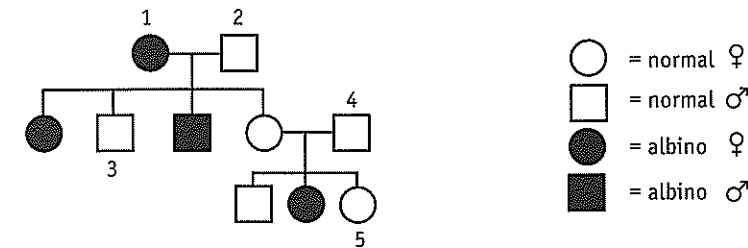
- (a) Write down the genotype of a:
(i) black ♂ cat; (iii) black ♀; (v) tortoiseshell ♀.
(ii) orange ♂ cat; (iv) orange ♀;
(b) Can tortoiseshell male cats exist? Explain.
(c) Work out the percentage chances of each of the following matings producing tortoiseshell cat offspring.
(i) black ♂ × orange ♀ (iii) black ♂ × tortoiseshell ♀
(ii) orange ♂ × black ♀ (iv) orange ♂ × tortoiseshell ♀

1 GENETICS

Genetics and pedigree charts

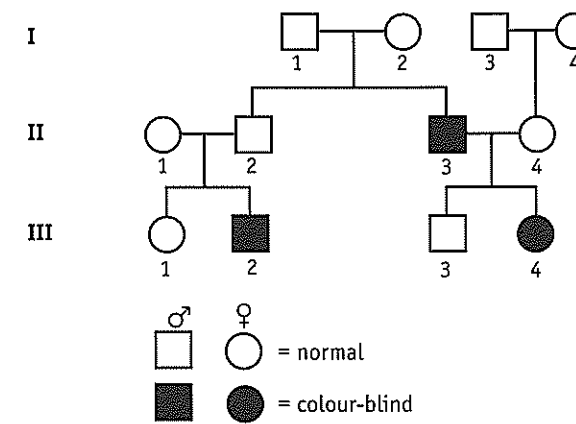


1 Albinism is an autosomal condition (i.e. the gene is carried on chromosomes other than the sex chromosomes) and it is recessive. Albinos have the genotype 'aa' and lack any body pigmentation of hair, skin or iris. A family pedigree for the condition is shown below.



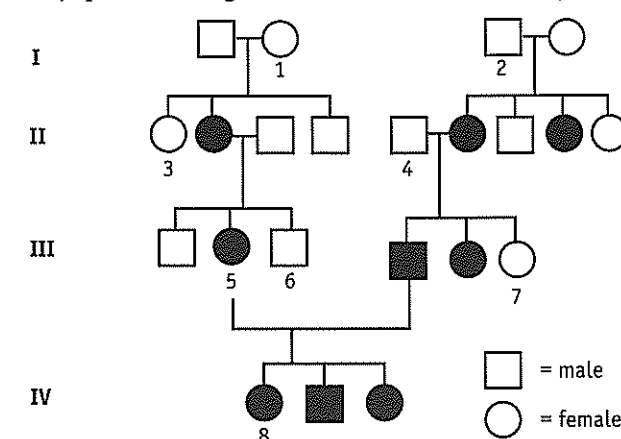
- (a) Work out the genotype of all individuals (1 to 5).
(b) What evidence is there in the pedigree that albinism is:
(i) a recessive trait;
(ii) not sex-linked?

2 Study the pedigree chart showing the incidence of colour blindness in a family over three generations (I, II and III). Colour blindness is due to a recessive, sex-linked gene (c).



- (a) Write down the genotypes of all individuals shown in the pedigree.
(b) Work out the phenotypes of all possible offspring that could be produced by the following marriages:
(i) I3 × I4
(ii) II3 × II4
(iii) III2 × III4
(c) What family relationship exists between individuals III2 and III4?

3 Myopia (near-sightedness) is an inherited eye condition traced in the following family pedigree chart.



- (a) What evidence in the pedigree suggests that:
(i) the disorder is recessive;
(ii) the disorder is not sex-linked?
(b) Determine the genotypes of all individuals (1 to 8).
(c) Calculate the percentage chance of myopia affecting a child produced in the following marriages:
(i) III6 × III7
(ii) II4 × III5