

Sex-Linked Traits



Normal Vision



Colourblind

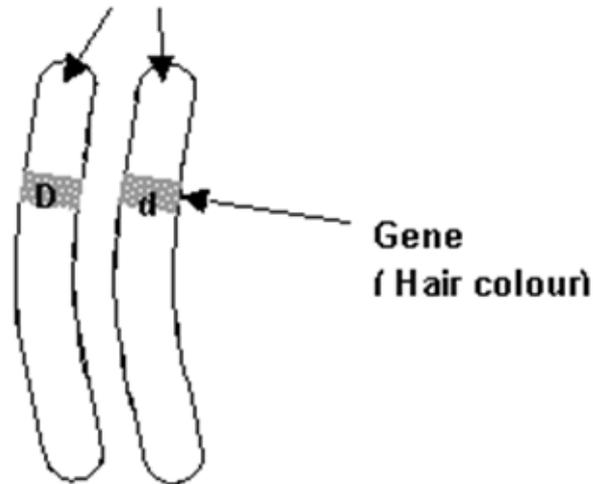
S1-1-14 Explain the inheritance of sex-linked traits in humans and use a pedigree to track the inheritance of a single trait. Examples: colour blindness, hemophilia

Genes & Alleles...

Genes

- **Genes** are a PIECE of CHROMOSOME that contains the actual CODE for a certain TRAIT.
- There must be a gene for HAIR COLOUR, LEFT-HANDEDNESS and so on.
- Every CHARACTERISTIC we have must have a corresponding GENE in our chromosomes.

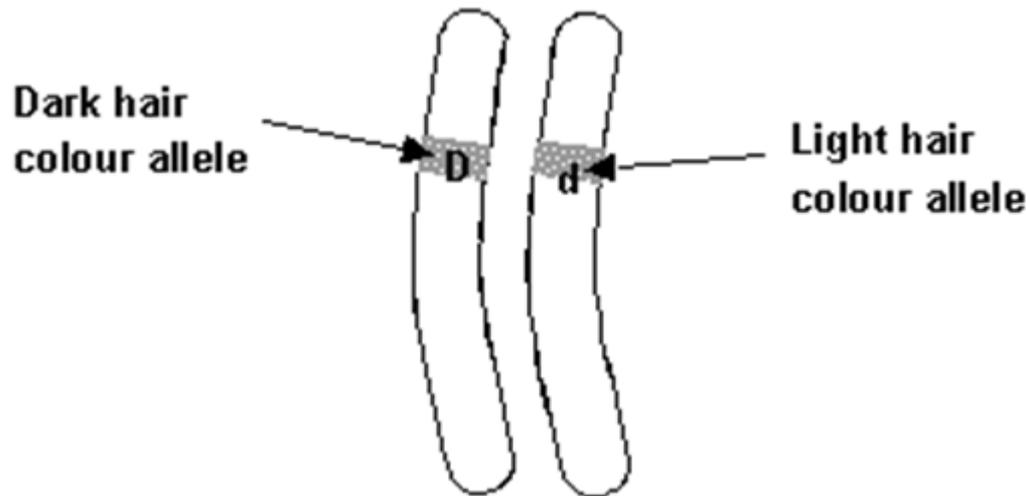
Homologous chromosomes



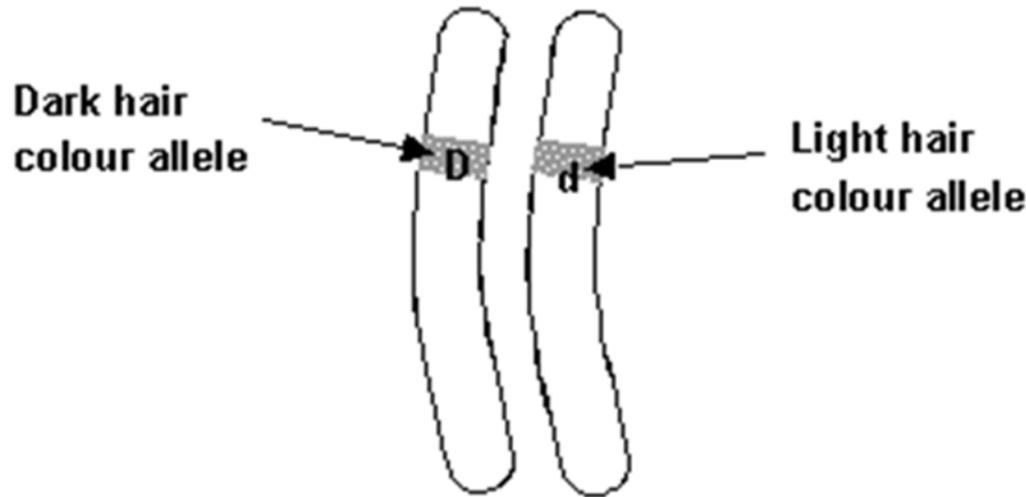
Genes & Alleles...

Alleles

- An **allele** is a **FORM** of the **GENE**. For example in the homologous chromosomes shown in the diagram there is a **GENE** for **HAIR COLOUR**.
- Alleles for hair colour can be **DARK(D)** or **LIGHT(d)**, where **DARK** hair colour is the **DOMINANT** allele.



Genes & Alleles...

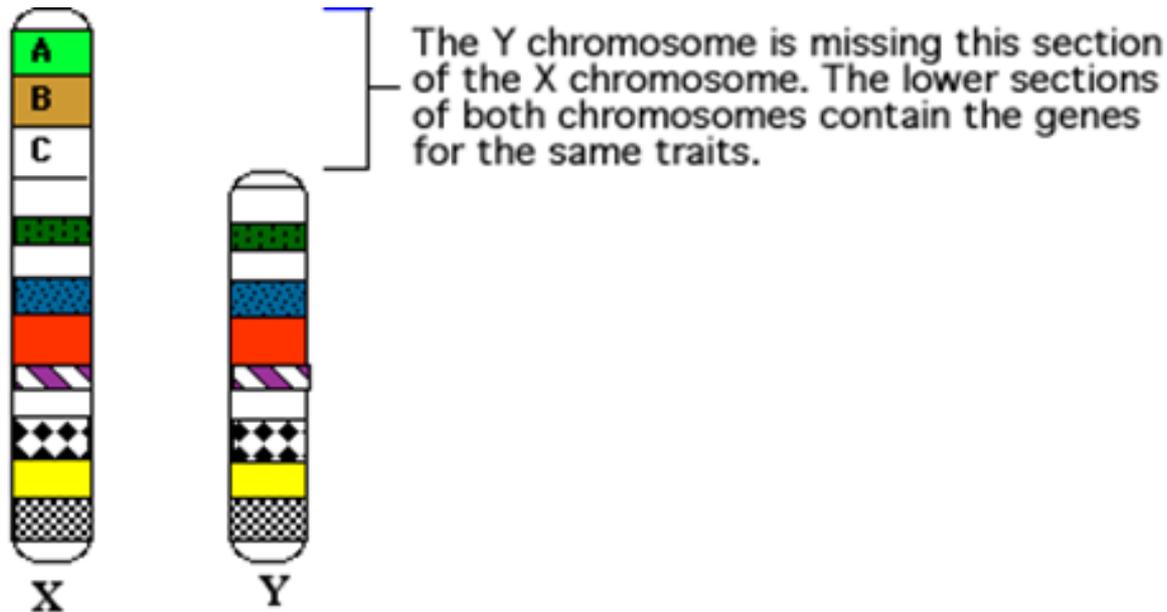


- After **MEIOSIS** has taken place, only one of the **HOMOLOGOUS CHROMOSOMES** will give genetic information from this parent to the offspring.
- This means the parent in the example can contribute either a **DARK** hair **DOMINANT** allele or **LIGHT** hair **RECESSIVE** allele to the offspring.
- Whether the offspring will have light or dark hair will depend on the **ALLELES** contributed by **BOTH PARENTS**.

Sex-Linked Traits...

Sex-linked traits are traits carried on SEX CHROMOSOMES (X AND Y).

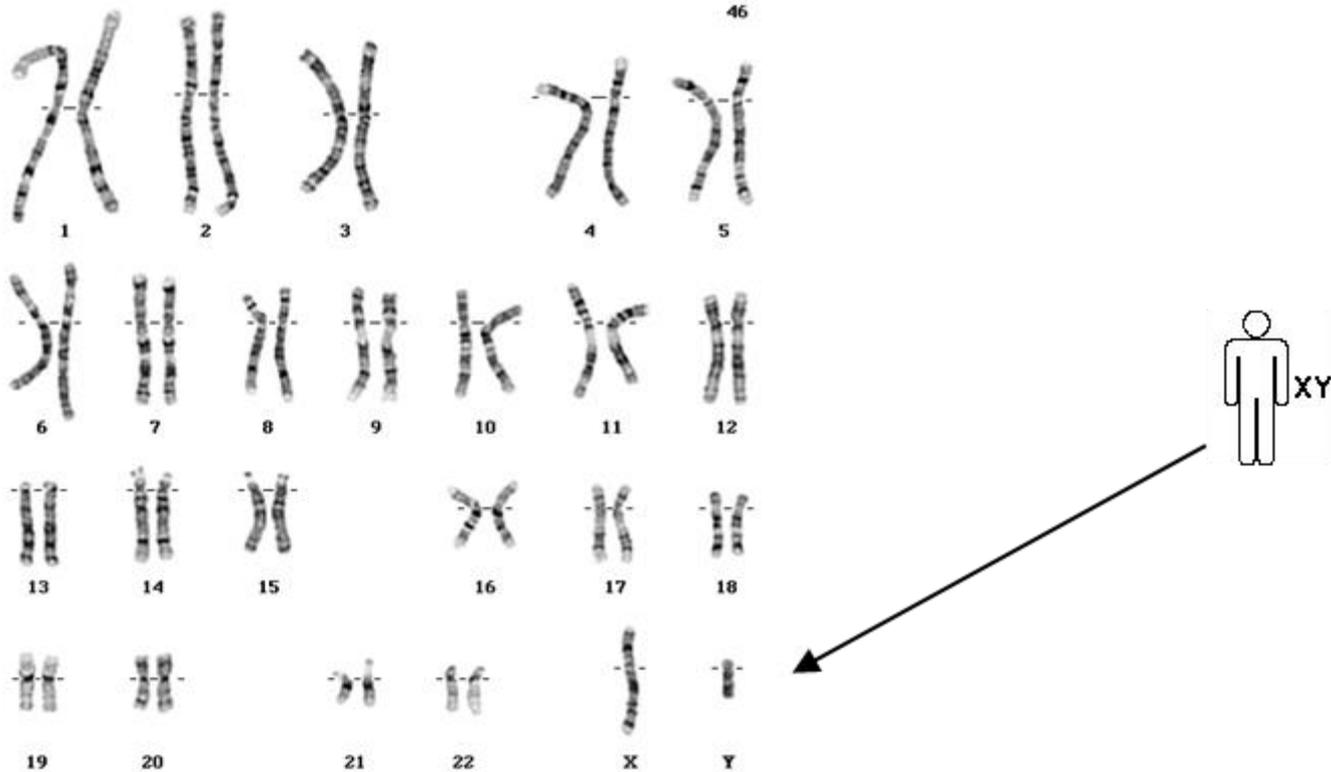
The male determining chromosome(Y) has no corresponding ALLELES on the X chromosome to MASK ITS EFFECTS.



The presence of the Y chromosome causes "MALENESS". The female determining chromosome(X) does not carry MALE GENES of the Y chromosome

Sex-Linked Traits...

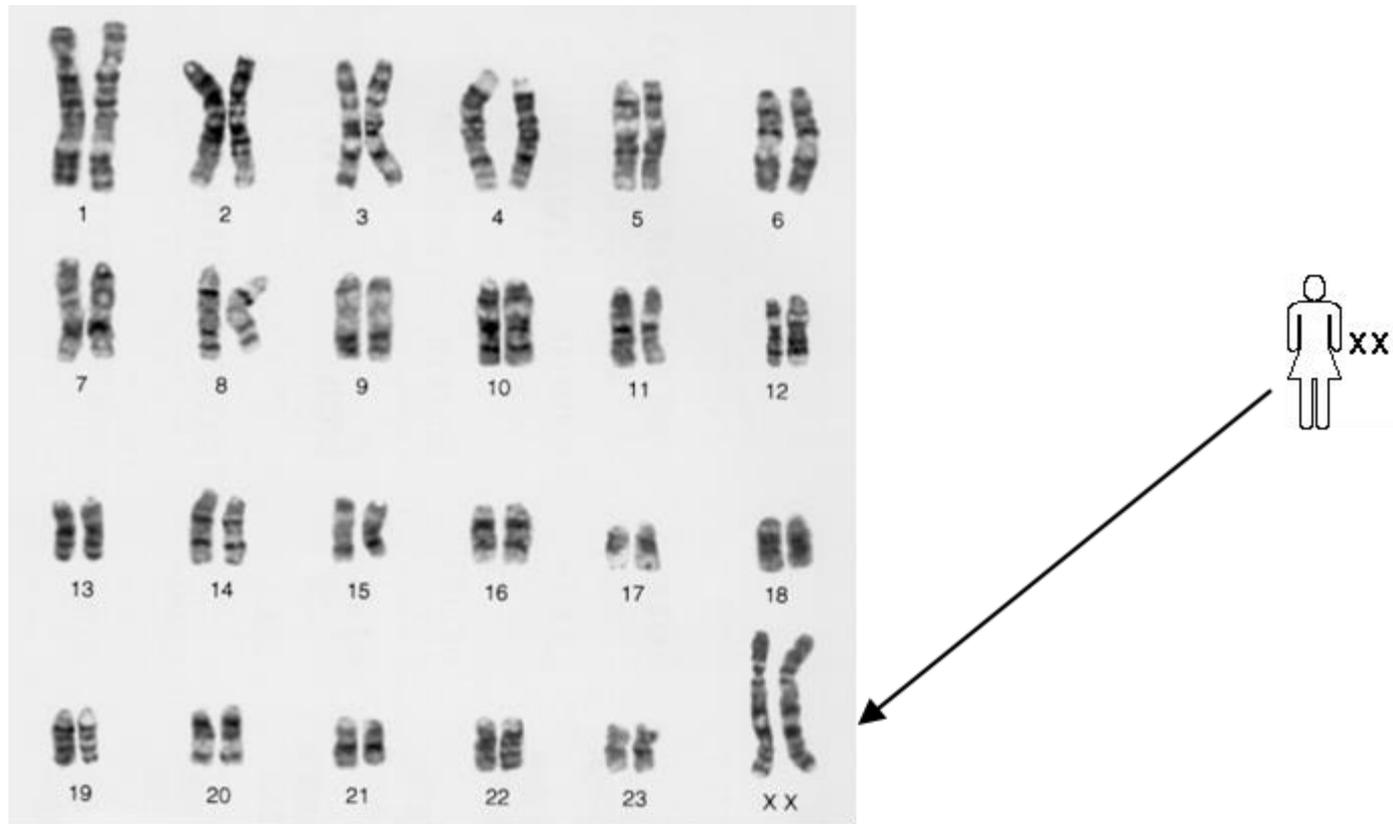
A male has XY homologous chromosomes for sex determination



The male has one X and one Y sex chromosome. Since Y genes can't be masked by genes on the X CHROMOSOME, he is male.

Sex-Linked Traits...

A female has XX homologous chromosomes for sex determination



The female has two X sex chromosomes. Since there are no male, Y-BASED GENES, she is female.

Sex-Linked Traits...

The X and Y chromosomes also carry genes that code for traits other than gender. Traits determined by genes on the **X CHROMOSOME** are called **SEX-LINKED**.

Some of these sex-linked traits show up as **DISORDERS** like **HEMOPHILIA** and **COLOUR BLINDNESS**.

→ the genes for these disorders are **RECESSIVE** and found only on the **X-CHROMOSOME**.

Ex) Colour blindness is recessive to normal vision. This is disorder mostly found in men. Why?

Males do not have a second X chromosome to mask disease

Males and Sex-Linked Traits...

Males receive X chromosomes from their mothers only.



Sex-linked traits are always on the X CHROMOSOME and a male only has one

If he receives an X chromosome with a SEX-LINKED allele on it, he will always DEMONSTRATE that trait because there is no corresponding ALLELE on the Y chromosome to MASK IT.

Females and Sex-Linked Traits...

Females receive X chromosomes from both parents and therefore can inherit sex linked traits from either parent.



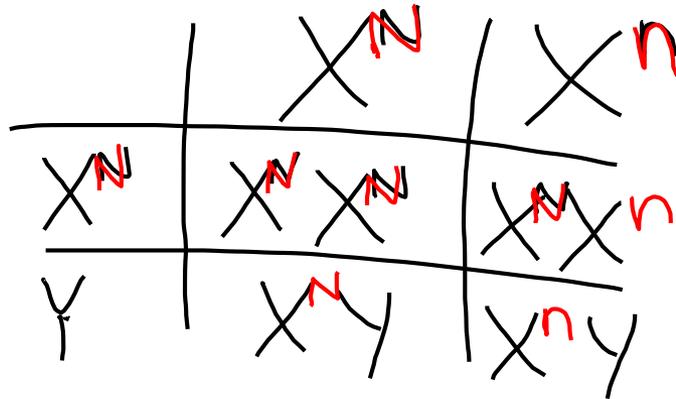
If a female is to show a sex-linked trait, she must have one **DOMINANT ALLELE** on an **X** chromosome or two **RECESSIVE ALLELES** on both **X** chromosomes.

If a female receives **ONE RECESSIVE** sex-linked allele from her mother or father she **WILL NOT** show the trait, but she is a **CARRIER** and there is a probability that she will pass the sex-linked trait **TO ONE-HALF OF HER SONS.**

Punnett Squares & Sex-Linked Traits...

Example:

A woman who is heterozygous for colour-blindness (a carrier) has children with a man with normal vision. What genotypes and phenotypes will result?



The heterozygous mother who does not exhibit colour-blindness has a **50%** chance of producing a **COLOUR-BLIND** son and **ZERO** chance of producing a **COLOUR-BLIND** daughter.

The **HOMOZYGOUS DAUGHTER** will not have any **COLOUR-BLIND** offspring if she has children with a **NORMAL VISION** male. The **HETEROZYGOUS DAUGHTER** will produce offspring with the **SAME RESULTS** as the mother.

Punnett Squares & Sex-Linked Traits...

Example 2:

What kind of offspring result from a colour-blind father and heterozygous normal mother?

	X^N	X^n
X^n	$X^N X^n$	$X^n X^n$
Y	$X^N Y$	$X^n Y$

The colour-blind father has

- A **25%** chance of producing a **COLOUR BLIND DAUGHTER**
- A **25%** chance of producing a **COLOUR-BLIND SON**.

If the colour-blind daughter now married a colour-blind male, the offspring would have **100% COLOUR-BLINDNESS**

Punnett Squares & Sex-Linked Traits...

The probability of having a homozygous colour-blind female and a colour-blind male producing offspring is not common in the general population.

If however, there were significant inbreeding, that is if relatives with a sex linked disease intermarried, then a problem can develop.

An example genetic diseases and sex linking can be seen in European aristocracy. Royalty knew no national boundaries in Europe. Intermarriage among nations was so common that a Russian Prince could have a genetic background that was mostly British. A sex-linked gene for hemophilia was introduced through marriage. Through intermarriage the female carrier would infect the males to such an extent that it became a problem.