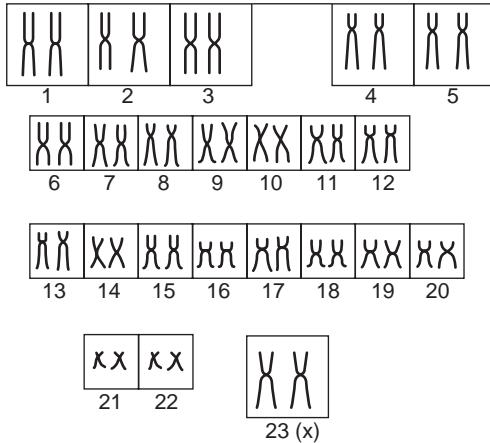


# Sex linkage and the inheritance of sex

**A KARYOTYPE** is obtained by rearranging photographs of stained chromosomes observed during mitosis. Such a karyotype indicates that

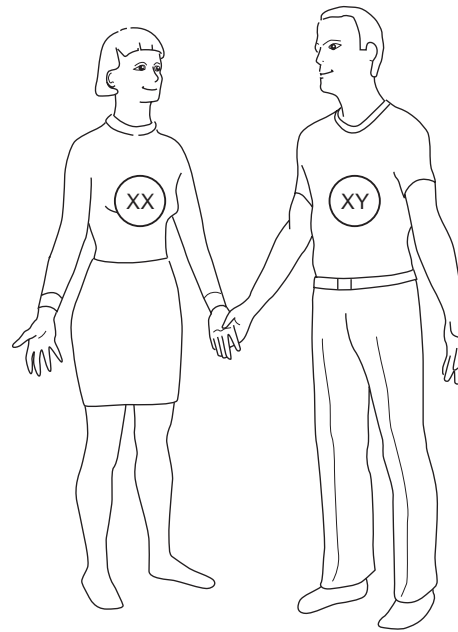
- the chromosomes are arranged in **homologous pairs**. In humans there are 23 pairs and we say that the **diploid number** is 46 ( $2n = 46 = 2 \times 23$ ).



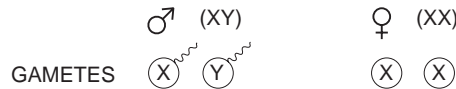
- whereas females have 22 pairs + XX in the karyotype, males have 22 pairs + XY i.e. the 23rd 'pair' would **not** be two copies of the X chromosome.



The Y chromosome is so small that there is little room for any genes other than those responsible for 'maleness', but the X chromosome can carry some genes as well as those for 'femaleness' - these additional genes are **X-linked** (usually described as **sex-linked**).



**INHERITANCE OF SEX** is a special form of monohybrid inheritance



F<sub>1</sub> generation: sex of offspring can be determined from a Punnett square

♂ GAMETES	X	Y
♀ GAMETES	X	Y
X	XX (female)	XY (male)
X	XX (female)	XY (male)

- theoretically there should be 1 : 1 ratio of male : female
- the male gamete determines the sex of the offspring

**SEX LINKAGE:** Genes on the X chromosome can be inherited by either sex, but the male can only receive **one** of the possible alleles as he **must** be XY. The female will be XX and thus may be **either homozygous or heterozygous** for the X-linked allele.

For example, **haemophilia** (in which blood fails to clot properly) is an X-linked condition.

Normal allele = H, mutant allele = h

PARENTS  $X^H X^h$  ×  $X^H Y$

female, normal phenotype but a carrier of the mutant allele

male, normal phenotype

GAMETES  $X^H$   $X^h$   $X^H$   $Y$

F <sub>1</sub> OFFSPRING	♂ GAMETES	$X^H$	Y
♀ GAMETES	$X^H$	$X^H X^H$	$X^H Y$
	$X^h$	$X^h X^H$	$X^h Y$

i.e. two 'normal' parents can produce a haemophiliac son

N.B. A haemophiliac daughter ( $X^h X^h$ ) could only be produced if **both** parents contributed  $X^h$  i.e. if the father was haemophiliac, in which case his condition would be known and the daughter's condition might be expected.

Another important X-linked condition is **red-green colour blindness**.

Many more males than females cannot distinguish red from green