

The Sex Chromosomes and Sex Determination

The Sex Chromosomes

The sex chromosomes include the X and Y chromosomes, which have a crucial role in sex determination. Males are defined by XY chromosomes and females by XX.

X chromosome

- Has more than 153 million base pairs
- Represents about 5% of the total DNA in women's cells, 2.5% in men's
- Contains about 2000 genes compared to the Y chromosome containing 78 genes, out of the estimated 20,000 to 25,000 total genes in the human genome
- Genetic disorders that are due to mutations in genes on the X chromosome are described as X linked.
- X chromosome inactivation is when most genes on one of the two X chromosomes in females are inactivated and do not produce any product. In somatic cells in normal females (but not in normal males), one X chromosome is inactivated early in development, thus equalizing the expression of X-linked genes in the 2 sexes. In normal female cells, the choice of which X chromosome is to be inactivated is a random one. Thus females are mosaic with respect to X-linked gene expression. In patients with extra X chromosomes, any X chromosome in excess of one is inactivated, but not all genes on that chromosome are inactivated.

Y chromosome

- Much smaller than X
- Carries only a few genes of functional importance, e.g. the TESTIS-DETERMINING FACTOR (also SRY protein – Sex-determining Region Y): certain genes that cause the male sex organs to develop. It is located on the short arm of the Y chromosome close to the pseudoautosomal region (see below).

In male meiosis, the X and Y chromosomes normally pair by segments at the ends of their short arms and undergo recombination in that region. The pairing segment includes the PSEUDOAUTOSOMAL region of the X and Y chromosomes so called because the X and Y-linked copies of this region are homologous to one another like autosomes.

Sex Determination

In females each ovum carries an X chromosome, whereas in males each sperm carries either X or Y. As there is roughly equal chance of either X-bearing sperm or Y-bearing sperm fertilizing the ovum, the numbers of male and female conceptions are approximately equal.

	X chromosome	Y chromosome
X chromosome	XX	XY
X chromosome	XX	XY

Links

Related Articles

- Disorders of the Sex Chromosomes
- Sexual Differentiation

Bibliography

References