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ZO 354: Genetics

Semester V

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3.11 Sex Determination :

The mechanism by which sex is established is termed as **sex determination**. The term sex refers to sexual phenotype. In some species, both male and female reproductive organs are present in same organism. It is described as **bisexual** or **hermaphrodite** or **monoecious**. On the other hand some species in which the organismhas either maleor female reproductive organs is said to be **Unisexual** or dioecious Humans are dioecious.

German biologist, **Henking** in 1891, while studying spermatogenesis of the squash bug (*Anasa tristis*), noted that 50% of sperms receive the unpaired chromosomes while other 50% sperm do not receive it. Henking gave a name to this structure as the x-body but he could not explain its role in sex determination. On the other hand, some species in which the organism has either male or female reproductive organs, is said to be **dioecious** Further investigations by other scientists led to conclusion that the "**x-body**" of Henking was infact a chromosome and gave the name

A) Sex Determination in human beings:

The chromosomal mechanism of sex determination in human beings is XX-XY type. In human beings, the nucleus of each somatic ell contains 46 chromosomes or 23 pairs of chromosomes. Out of these, 22 pairs are **autosomes** and one pair of **sex chromosomes**. Human female has a pair of XX, homomorphic sex chromosomes while male has XY, heteromorphic sex chromosomes. Thus genotype of :

Female = 44 Autosomes + XX

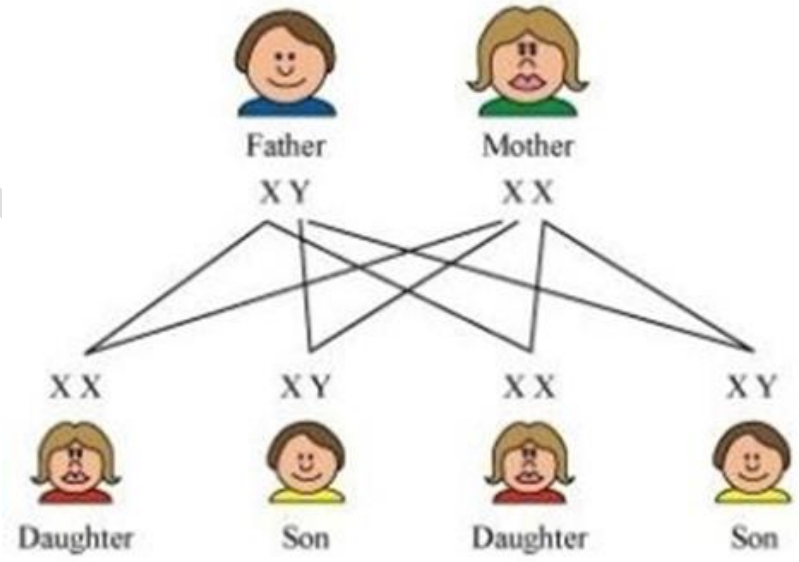
Male = 44 Autosomes + XY

During gamete formation in male the diploid germ cells in testis undergo spermatogenesis to produce two types of haplaid sperms, 50% sperms contain 22 autosomes and X chromosome while, 50% sperms contain 22 autosomes and Y chromosome.

In Female, the diploid germ cells in ovaries undergo oogenesis to produce only one type of egg. All eggs contain 22 autosomes and X chromosome. Thus human male is heterogametic and female is homogametic.

If sperm containing X chromosome fertilizes egg (ovum), then diploid zygote is formed, that grows into a female child. If sperm containing Y chromosome fertilizes the egg, then diploid zygote is formed that grows into a male child.

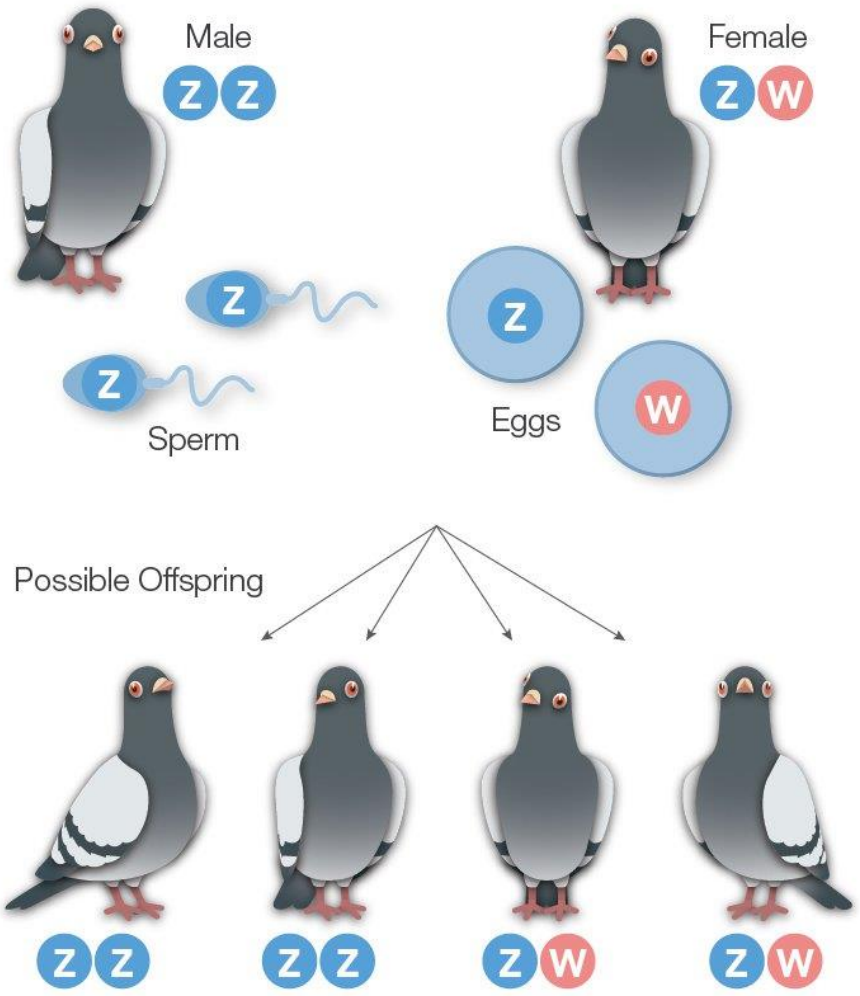
This indicates that the sex of a child depends on the type of sperm fertilizing the egg and **hence the father is responsible for determination of sex of child and not the mother**. Due to lack of knowledge, women are often blamed for giving birth to female child.



B) Sex Determination in birds:

In birds, the chromosomal mechanism of sex determination is ZW-ZZ type. In this type females are heterogametic and produce two types of eggs; 50% eggs carry Z- chromosome, while 50% eggs carry W- chromosome.

Males are homogametic and produce one type of sperms. Each sperm carries a Z chromosome. Thus sex of individual depends on the kind of egg (ova) fertilized by the sperm.



C). Sex Determination in honey bees:

In honey bees, chromosomal mechanism of sex determination is **haplo-diploid type**. In this type, sex of individual is determined by the number of set of chromosomes received. Females are diploid (2n=32) and males are haploid (n=16). The female produces haploid eggs (n=16) by meiosis and male produces haplaid sperms (n=16) by mitosis. If the egg is fertilized by sperm, the zygote develops into

a diploid female (2n=32) (queen and worker) and unfertilised egg develops into haploid male (n=16) (Drone) by way of parthenogenesis.

The diploid female gets differentiated into either worker or queen depending on the food they consume during their development. Diploid larvae which get royal jelly as food develops into queen (fertile female) and other develops into workers (sterile females).